CMFRI

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ANNUAL REPORT
2008-09

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ICAR

Central Marine Fisheries Research Institute

Annual Report

2008-2009

भाकृ अनुप
ICAR

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
Indian Council of Agricultural Research
Post Box No. 1603, Ernakulam North P.O., Cochin - 682 018, India

www.cmfri.org.in

CMFRI Annual Report 2008-2009

Published by
Dr. G. Syda Rao
Director

Editors
Dr. E.V. Radhakrishnan
Rekha J. Nair
N. Venugopal

Word Process and Secretarial Assistance
Mrs. Manjusha Menon

Hindi Translation
Mrs. P.J. Sheela

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Back Cover : Cage fabrication and launching

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PREFACE

With the overall estimated total landings transcending three million tonnes, the Indian marine fisheries sector is poised to enter a new R&D trajectory. The fisherfolk who has been witnessing a resource plateau with an average annual landings hovering around 2.5 million tonnes for the last one decade have reasons to be jubilant. It is worth to recall that it was in 1970 that we crossed the one million tonnes mark and then waiting until 1989 to see another surge of more than two million tonnes. The achievement underscores the importance of a number of corollaries like fishing technological prowess, ingenuity and entrepreneurial endowment of stakeholders coupled with the emergence of a scientifically informed governance system in the marine fisheries sector of the country. But given the disturbing signals on the effort front which is characterized by overcapacity and overcapitalization as well as the biological reference parameters, the propensity to construe this as an occasion for plenitudinous revelry needs to be constrained with precautionary concerns over ecosystem sustainability.

The livelihood of the coastal fishing community or the stakeholders of the fishery sector plays a significant role in the successful implementation of any marine fisheries management measures. With limited scope for further increase in catch from the coastal waters, there is a need to manage the coastal fisheries to sustain and ensure the livelihood of coastal fishermen, and seafood to the consumers. The lack of economic security among the stakeholders often leads to indiscriminate harvest of the fishery resources resulting in irreparable damage to the fishery sector. This emphasises our responsibility to show them the way to the successfully implantable and sustainable income earning alternate livelihood options (ALO's), which will help to reduce the pressure of fishing in the seas.

It has been our constant endeavor to monitor the ecological well being of the resource base in such a way that we have never failed to enact the role of a responsible *sentinel* releasing relevant policy advices for marine fisheries management. It is in this spirit that the results of a nationwide resource appraisal project have been consolidated to bring out a new series of policy briefs specific to the requirements of each maritime state.

Our Institute has a unique distinction of estimating the country's marine fish catch and assessment of marine fish stocks for the last 60 years. The need for improving

the mechanism of catch data collection and stock estimates is keenly felt to arrive at scientific management policies for sustaining marine fish stocks. Hence, CMFRI has planned to strengthen fish catch data collection by increasing the coverage, introduction of electronic gadgets, and digitizing the historic data available with the Institute. The Institute is planning to take a few initiatives in this direction, which will help to (i) increase the coverage and lead to better, spatial and temporal estimates of fish catches at species level (ii) robust stock estimates and develop fisheries prediction models and (iii) evolve scientifically designed fisheries management options for sustaining the resources.

In the context of declining catch and catch rates of marine capture fishery sector in India, development of commercial level sea farming activities is inevitable for enhanced seafood production. The Institute initiated a few research projects to concentrate on sustainable capture-based aquaculture (CAB). These studies focused on selection of candidate species for CAB, standardization of commercial level seed production techniques for selected species and related aspects including development of fish feed.

The Action Research efforts we have embarked to perfect the capture based culture technologies got a shot in the arm last year with the replication of successful demonstrations of open sea cage culture in ten different locations in the country. Open sea cage culture has immense potential in India not only in terms of food security but also in terms of export earnings from high value species. China, having more than 4000 such cages, has invested about 20 billion dollars in the popularization of this technology. We are working on the development of hatchery technology for more number of candidate species as well as further reduction in the cost of fabrication of the cage which is estimated to be about Rupees three lakhs (for a 5 meter diameter cage) now. However, it is well understood that mariculture is still in its infancy in India. Policy interventions on several technical, social, economic and legal issues are essentially required for the development and expansion of mariculture in India. It is our hope that our country will soon make her presence felt among the comity of nations who have open sea mariculture technology.

We have just completed our diamond jubilee and it indeed was a nostalgic trip down the memory lane when we had the SRC at Mandapam this year. It also gave us an opportunity to redeem our commitment to the accomplishment of mandated duties bestowed upon us with a new vigour and collective sense of purpose. It is hoped that our focused research efforts will have a palliative effect while contouring the necessary paradigmatic transitions in meeting the emerging challenges of resource enhancement, alternate livelihood options, climate change, biodiversity threats and trade related international concerns in the sector.

G. Syda Rao
Director

25th August, 2009

Executive Summary

During this year marine fish landings in India has touched the 3.21 million tonne mark with an increase of about 3.27 lakh tonnes (11.3%) against the estimate of the previous year. Pelagic finfishes constituted 53%, demersal 27%, crustaceans 15% and molluscs 5% of the total landings. Oil sardine *Sardinella longiceps* was the single largest contributor to marine fish landings with 4,44,593 t (14%) during the year, followed by penaeid shrimps (64%). The west coast was the highest contributor among regions and Kerala among states (21%) followed by Gujarat (19%). The estimated value of the total marine fish landings at the primary market level increased by 29% over 2006 touching Rs.17,133 crores and earning over Rs.24,934 crores in the retail market level. The percentage share of fishermen in consumer rupee (PSFCR) has also increased over the years. Simulation exercises using Schaeferian studies were attempted to compare the published value of these parameters and the outcomes thrown up by various distributions.

Marine fish landings along the Kerala coast have been showing an increasing trend during the past few years. 6.7 lakh tonnes of marine fish were landed during 2008, showing an increase of 8% over the previous year; the MSY was estimated at 6.99 lakh tonnes. Pelagics, mainly oil sardine accounted for the lion's share of landings (71%) and the most productive period was the post trawl ban period; heavy landings of juvenile oil sardine in ring seine was also recorded. High value fish like coastal tuna and oceanic tuna registered a growth of 23% and 39%, respectively. The APY and PY for Tamil Nadu and Puducherry have been worked out at 396880 t and 435479 t respectively. The decrease in the mean size of some of the penaeids point to the fact that an increase in trawl effort may affect the spawning stock biomass of the resource. Gastropod fishery has shown an overall increase in Kerala. The acute live bait shortage experienced by the pole and line fishing units at Minicoy and Agatti during November to January indicate the urgent need for sustainable management of live bait resources. Quicker dissemination of PFZ forecast through Fisheries Communication Network and the effective deployment of the units can reduce scouting time as well as fuel consumption, leading to an increase in tuna catch. Marine fish landings in Karnataka and Goa registered 13% and 14% increase, respectively over the previous year. Multiday trawls contributed 48% to the landings in Karnataka. Though oil sardines constituted the major group followed by threadfin breams, cephalopods and shrimps took the lion's share in economic value.

Studies on the exploitation pattern of oceanic tuna indicate its potential as a possible candidate for further exploitation while coastal tuna production has nearly reached optimum level. The targeted fishery for the deep sea sharks on the west coast landed more than 14 species of sharks as well as chimaeras. Bramble shark landings by drift gill netters (DGN) is on the increase in Cochin during post trawl ban period. Low value bycatch landed and discarded by trawlers was monitored at all major fish landing centres. *Thalluvalai* operations at Tiruppalaikudi and Devipatnam have resulted in large scale exploitation of juvenile female shrimps which might harm the natural stock of the resource. Large scale operations of *thalluvalai* should be looked into seriously. Recruitment dynamics of penaeid shrimps along the Indian coast are being investicated; a declining trend in landings has been noticed at Mumbai and Mangalore. Under the NAIP scheme, three projects have been initiated. Under the project on 'A value chain on oceanic tuna fisheries in Lakshadweep sea' a fish feed CADALMIN SILO was developed from tuna silage and the low cost feed is undergoing trials in the laboratory as well as in the farmer's ponds. Participatory management measures towards conservation of lobster resources were undertaken with the objective of conserving the resource. Among the major pelagic resources exploited at Veraval, *Thunnus tonggol* was exploited above optimum level. Exploitation studies on the impact and vulnerability of marine fishes to climate change was studied further during the year. Studies have indicated that biomass of small pelagic herbivores in the ecosystem is likely to increase even under high fishing pressure. Based on CO_2 emission studies on mechanized crafts, gillnetters and dolnetters were found to be less emitters of CO_2 compared to mechanized boats. Studies on marine mammals of the contiguous seas were continued further. Cochin backwaters seens to be a good feeding and socializing ground

for the Indo-Pacific humpback dolphin *Sousa chinensis*. This points to the fact that this area is a hotspot for these animals. Around 1899 individual whales and dolphins were cited in the Indian seas. In Andhra Pradesh, marine fish landings showed a slight increase over the previous year; mainly due to pelagics like oil sardine, mackerel and ribbonfish. *Loligo duvauceli, Metapenaeus monoceros* and *M.dobsoni* were exploited well above the optimum level; this was reflected in their landings also. As part of the demonstration of responsible fishing practices for trawl fisheries of Gujarat state, initial trials using MFRA notified mesh size were conducted.

Trophic modelling studies have shown that fished taxa diversity of Coramandal coast differs from Palk Bay and Gulf of Mannar. In these ecosystems, Principal Coordinate Analysis was conudcted using data archaeology. 17 species in Kerala and 4 species in Karnataka were classified as extremely rare or extinct as they have not been recorded in the fishery for the past 20 years. Catfish seans to be a depleted stock. Parts of fishing zone K1 and K2 in Kerala and KN14 in Karnataka were identified as MPAs based on biodiversity stress. Studies on the impact of urban domestic sewage and anthropogenic activities on marine environment was continued at eight coastal centres. Studies on the efficiency of the formulated feed on clown fish *Amphiprion percula* showed good colour retention and better survival. Initial studies using formulated feed on spiny lobster *Panulirus homarus* showed good results. DNA barcoding of six species of tuna and 3 species of catfishes were completed and the Co1gene sequences of the catfishes was deposited at the NCBI gene bank. As part of the pathogen profiling work of maricultured finfish and shellfish, myxosporean, acanthocephalan and nematode parasites were recorded from pearl oysters. Cell culture lines were developed from gill, spleen and heart tissues of *E pinephelus malabaricus.* On the bioprospecting front, development of a neutraceutical from the green mussel *Perna viridis* is in progress. Work on developing G1H antagonists as a replacement for the conventional eyestalk ablation technique is progressive, which will be a novel and faster method for growth acceleration and gonad maturation in crustaceans. On the biotechnology front, development of an indigenous enrichment substance for marine finfish larviculture feed is in progress.

Studies on poverty head count using PPAR in the traditional sector showed Karnataka to top the list followed closely by Tamil Nadu. Pilot scale culture of *Caranx sexfasciatus* in small cages was undertaken; survival was high indicating good potential for cage culture. Using underwater Line Intercept Transect method, percent coral cover and biodiversity of Palk Bay and GOMBR was studied. Compared to 2004, coral cover has decreased from 41% to 13 % in Palk Bay; alterations in community structure was also noticed. Studies on biodiversity and species variation of fishes of family Lutjanidae was initiated; 26 species of lutjanids were collected from different areas. On the mariculture front, experiments on broodstock development of Cobia, Pompano and Grouper were successful. Broodstock and production scaling up of eight species of marine ornamental fishes is in progress. Standardization of juvenile rearing of *P. biaculeatus* and capture breeding of *Pseudochromis dilectus* was achieved.

The Institute scientists published 7 books and special publications. 65 research papers in peer reviewed journals and a good number of technical and popular articles on important aspects of mariculture, biotechnology and marine fisheries were also published. Five scientists won awards at National level and two scientists won International scholarships; three were awarded their Doctoral Degrees for the work carried out in the Institute.

The Institute carried out a number of consultancy projects for the private and public sector worth Rs. 1 crore. Three multi-disciplinary and multi-institutional NAIP projects, on oceanic tuna, oceanic squids and on shellfish mariculture worth Rs. 10.3 crores were sanctioned. Under the NAIP project, A value chain on oceanic tuna fisheries in Lakshadweep Sea, a fish feed developed from tuna waste was released. Scientists of this institute were also able to win a number of externally funded projects from Ministry of Earth Sciences (MoES), Department of Biotechnology (DBT), DST and MPEDA. The highlight of the year was that the Institute could get two major projects on open sea cage culture demonstration in India from National Fisheries Development Board and Ministry of Agriculture, Government of India.

INTRODUCTION

Marine fish production in India during the last year has raised hopes of the sector strengthening the food security of India. After a static production of 2.97 million tonnes during the last decade, marine landings during this year has showed 11% increase over the previous year. Estimates of the fishery resource assessment show that the west coast is the most productive region. Pelagic resources continued to be the mainstay of the fisheries; penaeid and non penaeid shrimp landings have also increased over the previous year. Increase in landings of high value resources like cephalopods and tunas is a positive note. Fishing of juveniles should be avoided to sustain the fishery in the longer run. Dissemination of PFZ forecast for surface tunas through Fisheries Communication Network can help in effective increase of tuna catch.

Steps to effectively utilize the oceanic tuna of Lakshadweep Sea has been envisaged through the NAIP project. This is the first in the series of the Government-private joint venture. Partnerships like these have also been initiated in shellfish mariculture and for oceanic squids. The NAIP project on tuna will go along way in the development of the island both in terms of socio economics and technology.

Open sea cage farming of finfishes and sell fishes has been demonstrated successfully on both coasts of India. This will be a leap in capture based aquaculture (CBA) and a step closer to the dream of strengthening the food security of India. Biotechnology research on bioextraction from seaweeds and green mussel will strengthen the research front of CMFRI.

Central Marine Fisheries Research Institute has completed 62 years of service to the fisheries sector of India. Research infrastructure along with highly competent scientific and technical manpower have been the strength behind the Insitute's envious growth in this field. Multidisciplinary research approach coupled with state of the art laboratories and research centres have helped to develop the Institute India's premier fishery research Institute.

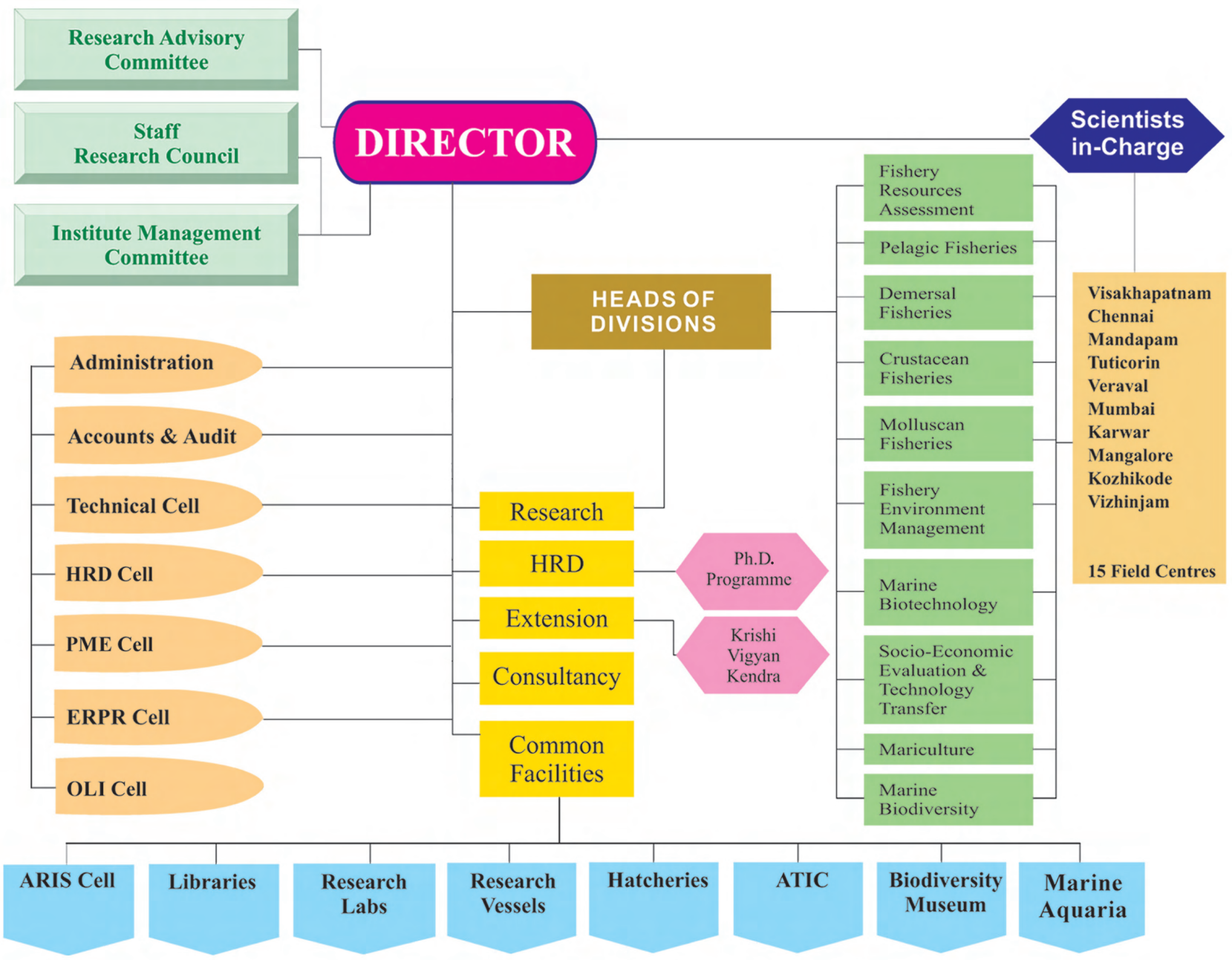
The mandate of the Institute adapts to the changing scenario in fisheries. To successfully achieve its mandate, the Institute monitors the various fishery resources landed all along the coastline, studies the impact of fishing and other anthropogenic activities on the marine ecosystems, develops mariculture techniques to increase fish production and undertakes research activities to monitor the marine environment and its biodiversity. Simultaneously, data archaeology and studies on the socio-economics and technological feasibility are also conducted.

Organizational setup

To effectively carry out these tasks, the Institute has established Regional Centres at Mandapam Camp, Veraval and Visakhapatnam, Research Centres at Mumbai, Karwar, Mangalore, Kozhikode, Vizhinjam, Tuticorin and Chennai and 15 Field Centres all along the coast. The entire activity

The Mandate

- *To undertake basic, strategic and applied research in marine fisheries and mariculture.*
- *To monitor and assess the fisheries resources of the Exclusive Economic Zone (EEZ) and to understand the stock and its dynamics in relation to environment and human interventions.*
- *To develop and commercialize hatchery and production system technologies for finfish, shellfish and other commercial marine organisms in coastal and open seas.*
- *To build up database on marine biodiversity, carry out research on fragile marine ecosystems for their conservation and restoration.*
- *To undertake research on utilization of potentially beneficial marine organisms.*
- *To act as a repository of information on marine fishery resources with a systematic and analytical database for policy interventions and to carry out research on social and economic costs and benefits of marine fisheries.*
- *To conduct front line demonstrations and training to develop human resource for R & D in capture fisheries and mariculture.*
- *To create awareness and provide training and consultancy services.*


Research Advisory Committee
Staff Research Council
Institute Management Committee
DIRECTOR
Scientists in-Charge
HEADS OF DIVISIONS
Administration
Accounts & Audit
Technical Cell
HRD Cell
PME Cell
ERPR Cell
OLI Cell
Research
HRD
Extension
Consultancy
Common Facilities
Ph.D. Programme
Krishi Vigyan Kendra
Fishery Resources Assessment
Pelagic Fisheries
Demersal Fisheries
Crustacean Fisheries
Molluscan Fisheries
Fishery Environment Management
Marine Biotechnology
Socio-Economic Evaluation & Technology Transfer
Mariculture
Marine Biodiversity
Visakhapatnam
Chennai
Mandapam
Tuticorin
Veraval
Mumbai
Karwar
Mangalore
Kozhikode
Vizhinjam
15 Field Centres
ARIS Cell
Libraries
Research Labs
Research Vessels
Hatcheries
ATIC
Biodiversity Museum
Marine Aquaria

is coordinated by the Headquarters at Cochin. The Institute has, over the years, built up laboratory, hatchery and farm facilities for carrying out research programmes and has been upgrading the same to meet the changing needs and additional requirements. The sanctioned staff strength of the Institute is: Scientific 173, Technical 330, Administrative 150, Auxiliary 6 and Supporting 262.

The multidisciplinary researches in capture and culture fisheries are conducted under ten Divisions: Fisheries Resources Assessment, Pelagic Fisheries, Demersal Fisheries, Crustacean Fisheries, Molluscan Fisheries, Fishery Environment Management, Marine Biotechnology, Socioeconomic Evaluation and Technology Transfer, Mariculture and Marine Biodiversity. Interdivisional and interinstitutional programmes are carried out for greater utililisation of expertise and facilities. Besides, the Institute also takes up short-term research projects on important and priority areas through *ad-hoc* research projects funded by outside agencies in the country and abroad, and offers consultancy services to the clients from Government organisations as well as private industry.

The Institute provides facilities for Ph.D. programmes of students working under sponsored projects. Teaching and guidance are provided by the scientists of the Institute.

The Krishi Vigyan Kendra imparts training in mariculture, agriculture, animal husbandry and other related subjects to fish farmers, agricultural farmers and farm women.

The Library and Documentation Section provides reference facilities to research staff and students of the Institute as well as to visiting scientists both from within and outside the country. The implementation of Hindi as Official Language is carried out by the Official Language Implementation Committee (OLIC).

The results of research carried out in the Institute are published in National and International journals. Besides, the Institute brings out Bulletins, Special Publications, Quarterly Newsletter and the Marine Fisheries Information Service and also publishes the Indian Journal of Fisheries.

Staff strength as on 31.03.2009

Name of Post	Sanctioned	In-position	Vacant
RMP	1	1	0
Scientific	173	103	70
Technical	330	279	51
Administrative	150	132	18
Supporting	262	205	57
Auxiliary	6	4	2
Total	922	724	198

Budget 2008 – 2009

The Budget and Expenditure under Non Plan and Plan for the financial year 2008 - 09 in respect of this Institute is as detailed below:-

(Figures in lakhs)

Budget Head	Non Plan		Plan	
	Budget Rs.	Expenditure Rs.	Budget Rs.	Expenditure Rs.
Estt. Charges	2560.00	2560.00	0.00	0.00
Wages	0.00	0.00	0.00	0.00
OTA	0.50	0.50	0.00	0.00
TA	25.00	25.00	30.00	30.00
Other Charges	405.00	405.00	515.00	515.00
Works	263.00	263.00	160.00	160.00
Other items including HRD	0.00	0.00	15.00	15.00
TOTAL	**3253.50**	**3253.50**	**720.00**	**720.00**

PENSION

Budget Head	Budget Rs.	Expenditure Rs.
Pension	1400.00	1400.00

LOANS & ADVANCES

Budget Head	Budget Rs.	Expenditure Rs.
Loans & Advances	22.00	22.00

OTHER PROJECTS

Budget Head	Budget Rs.	Expenditure Rs.
Other Non Plan Schemes	---	1.60
NAIP		60.70
Other Plan Schemes	---	22.87
Deposit Schemes	---	264.71
A.P. Cess Schemes	---	10.94
KVK, Narakkal		50.15
Consultancies	---	35.73

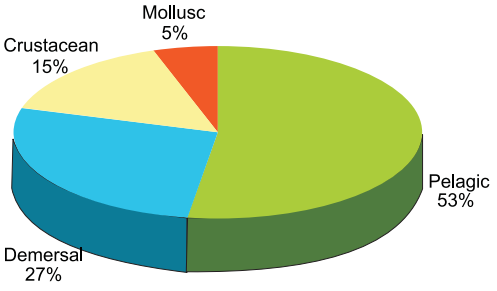
Heads	Target Rs.	Achievements Rs.
Revenue Receipts	58.00	63.53
Sale of assets	---	3.47
Interest on Short term Deposits	20.00	41.67
Recovery of Loans & Advances	55.00	59.66

PROJECT CODE	**FRA/ASSESS/01**
PROJECT TITLE	**Development of knowledge based information system for marine fisheries sustainability**
SCIENTISTS	**T.V. Sathianandan**, J. Jayasankar, Somy Kuriakose, T.M. Najmudeen, Mini K.G. and Wilson T. Mathew
CENTRES	Cochin and Chennai

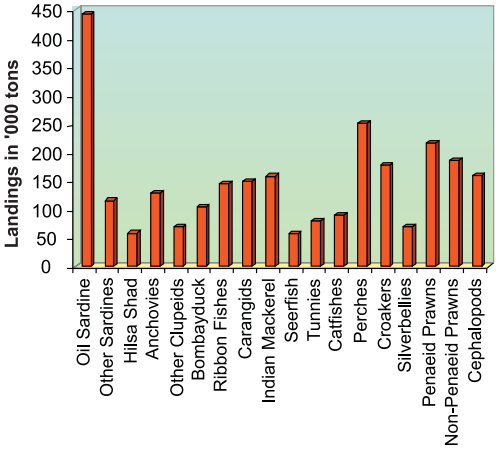
The project aims at estimation of marine fish landings and fishing effort for different regions of the country with individual species and gear break up and development of a full fledged information retrieval system pertaining to marine fisheries. For collection and estimation of marine fish landings of the exploited marine fishery resources the time tested Stratified Multistage Random Sampling Design was adopted which involved planning and execution of the sample survey, co-ordination of field work, processing of data, development of necessary computer software, creation and updating of database, development of formats for data storage and retrieval and development of database queries.

As part of the project computer software modules in C++ and Visual Basic were developed for the estimation of individual species level marine fish landings and exporting of information into MS Access database. Database and queries were developed with individual species estimates for 2007 and 2008. A data entry form exactly similar to the data entry sheets was developed integrating MS Access and Excel for entry of all the information collected from landing centres directly into the database and the field staff were trained to use it for data entry and data transmission through email. For maintaining data quality, a computer software was developed and introduced for checking the suitability of group codes and species codes entered in data files.

Region-wise and resource-wise estimates of marine fish production were made along with the effort expended by different types of gears. The estimate of region-wise production showed that the Northeast region, comprising of West Bengal and Orissa contributed 15% to the total production; Southeast region consisting of Andhra Pradesh, Tamil Nadu and Puducherry contributed 21%. On the west coast, the Northwest region comprising Maharashtra and Gujarat recorded 30% of the total, and the Southwest region comprising of Kerala, Karnataka and Goa contributed 34%.



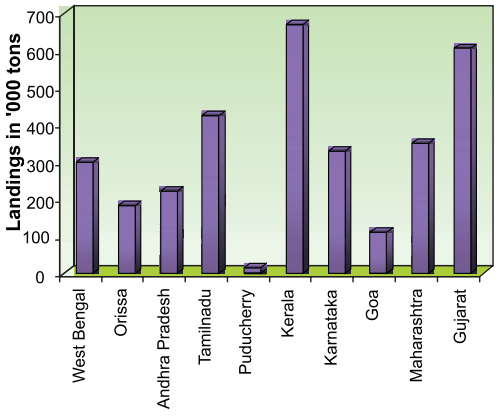
Percent composition of different resources



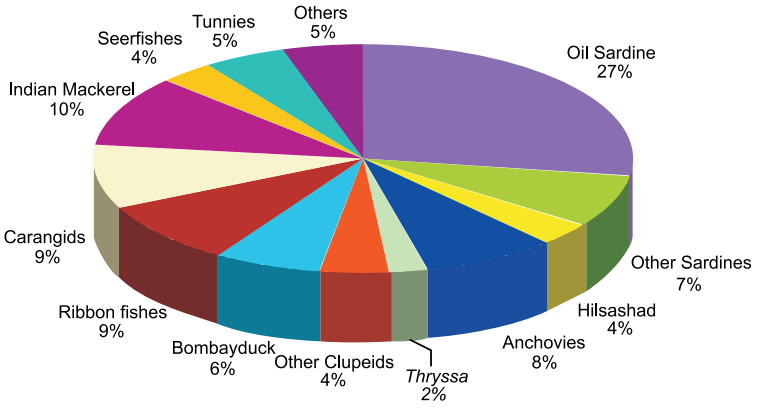
Landings of major fishery resources during 2008

Contribution of major species/groups

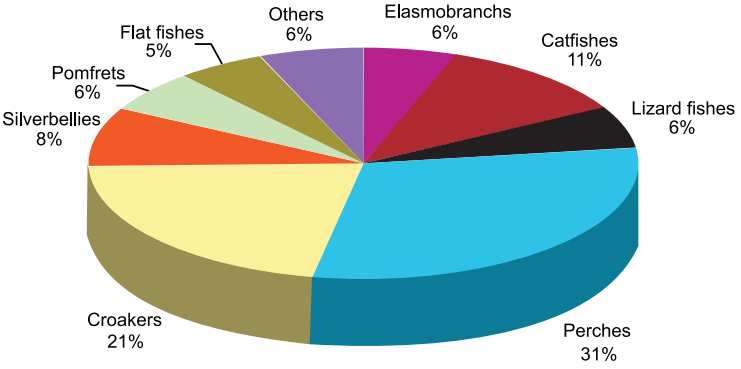
- Oil sardine landings decreased to 4,44,593 t (13.8% of total) from 4,96,988 t in 2007.
- Penaeid shrimp landings increased to 2,17,552 t (6.8% of total) from 1,95,599 t in 2007.
- Non-penaeid shrimp landings increased to 1,87,175 t (5.8% of total) from 1,38,983 t in 2007.
- Croaker landings increased to 1,79,092 t (5.6% of total) from 1,69,494 t in 2007.
- Cephalopod landings increased to 1,60,331t (5.0% of total) from 94,077 t in 2007.
- Indian mackerel landings decreased to 1,58,913 t (4.9% of total) from 1,80,117 t in 2007.
- Ribbonfish landings increased to 1,45,429 t (4.5% of total) from 1,31,733 t in 2007.



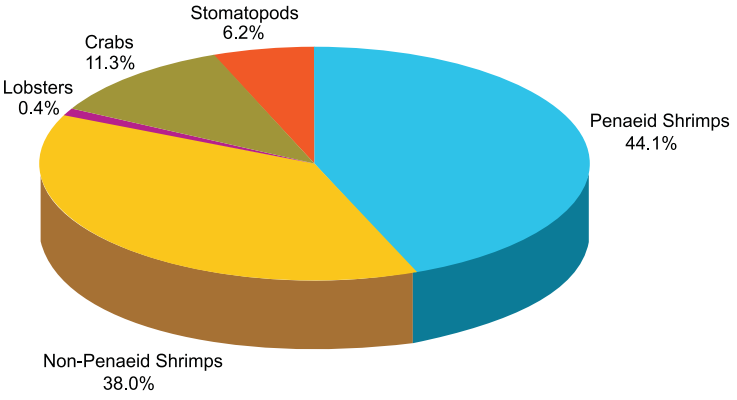
Statewise landings in India during 2008



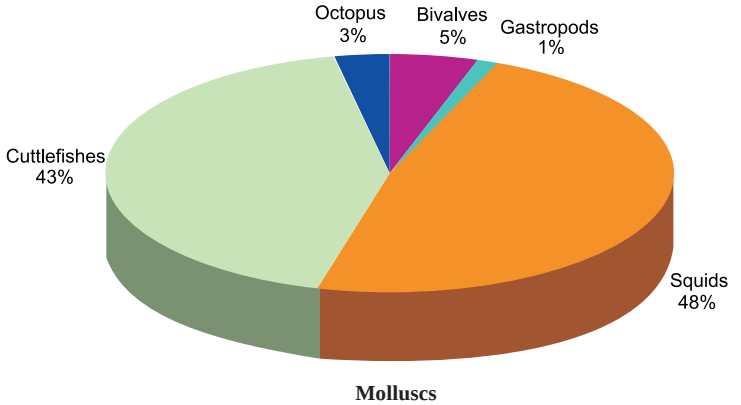
Pelagic finfish



Demersal finfish



Crustaceans



Molluscs

Components of marine landings during 2008

Estimated marine fish landings (t) during 2007 and 2008

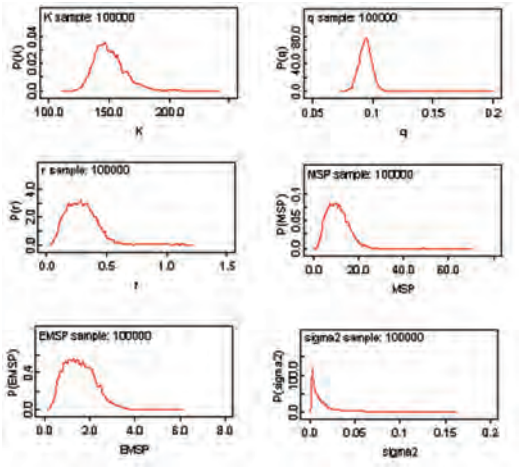
Group	Pelagic finfishes 2007	2008	Group	Demersal finfishes 2007	2008
CLUPEOIDS			ELASMOBRANCHS		
Wolf herring	15490	23126	Sharks	26598	25675
Oil sardine	496988	444593	Skates	2822	3530
Other sardines	95096	116098	Rays	16696	18246
Hilsa shad	52905	58875	EELS	12789	10843
Other shads	11398	7641	CATFISHES	65337	91338
Coilia	28760	31000	LIZARD FISHES	28526	52439
Setipinna	9441	10040	PERCHES		
Stolephorus	51681	87701	Rock cods	23261	19518
Thryssa	34950	36235	Snappers	4916	8580
Other clupeids	65031	70224	Pig face breams	10612	11821
BOMBAYDUCK	112273	104827	Threadfin breams	93160	126943
HALF BEAKS &			Other perches	53361	83980
FULL BEAKS	6062	6547	GOATFISHES	16494	22255
FLYING FISHES	2117	1559	THREADFINS	9203	10351
RIBBON FISHES	131733	145429	CROAKERS	169494	179092
CARANGIDS			SILVERBELLIES	70978	70112
Horse Mackerel	28285	30668	WHITEFISH	6153	8625
Scads	43400	35793	POMFRETS		
Leather-jackets	11606	13195	Black pomfret	13776	18948
Other carangids	57998	69843	Silver pomfret	31664	29063
MACKERELS			Chinese pomfret	3016	3834
Indian mackerel	180117	158913	FLAT FISHES		
Other mackerels	0	14	Halibut	941	1001
SEER FISHES	0	3	Flounders	105	156
Scomberomorus commerson	40309	33013	Soles	40841	38583
S. guttatus	20302	23919	MISCELLANEOUS	27662	31378
S. lineolatus	177	16	Total	728405	866311
Acanthocybium spp.	13	61	**SHELLFISH**		
TUNNIES			CRUSTACEANS		
Euthynnus affinis	27752	32406	Penaeid shrimps	195599	217552
Auxis. spp	11458	8693	Non-penaeid shrimps	138983	187175
Katsuwonus pelamis	3085	13088	Lobsters	1523	1868
Thunnus albacares	13206	13030	Crabs	40420	55729
T. tonggol	7036	5939	Stomatopods	25163	30532
Other tunnies	3724	6505	MOLLUSCS		
BILL FISHES	5447	6054	Cephalopods		
BARRACUDAS	19478	19141	Squids	35032	81577
MULLETS	6183	8994	Cuttle fishes	55449	73452
UNICORN COD	564	787	Octopus	3596	5302
MISCELLANEOUS	62926	61031	MISCELLANEOUS	7300	10743
Total	**1656991**	**1685001**	**Total**	**503065**	**663930**
			Grand total	**2888461**	**3215242**

Salient findings

- *The marine fish landings of India during the year 2008 has provisionally been estimated at 3.21 million tonnes with an increase of about 3.27 lakh tonnes (11.3%) against the estimate of the previous year.*
- *The pelagic finfishes constituted 53%, demersal fishes 27%, crustaceans 15% and molluscs 5% of the total landings.*
- *The sector-wise contributions during the year 2008 were : mechanized 74%, motorized 22% and artisanal 4%.*
- *The west coast accounted for 64% of the total landings.*

- Threadfin breams landings increased to 1,26,943 t (4.0 % of total) from 93,160 t in 2007.
- Lesser sardines increased to 1,16,098 t (3.6% of total) from 95,096 t in 2007.
- Bombay duck landings decreased to 1,04,827 t (3.3% of total) from 1,12,273 t in 2007.
- Catfish landings increased to 91,338 t (2.8% of total) from 65,337 t in 2007.
- *Stolephorous* landings increased to 87,701t (2.7% of total) from 51,681 t in 2007.
- Silverbellies landings decreased to 70,11 t (2.2% of total) from 70,978 t in 2007.
- Other clupeids landings increased to 70,224 t (2.2% of total) from 65,031 t in 2007

PROJECT CODE FRA/ASSESS/02
PROJECT TITLE **Decision support system for marine fisheries management**
SCIENTISTS **J.Jayasankar,** T.V. Sathianandan, Somy Kuriakose, Mini K.G. and Wilson T. Mathew
CENTRE Cochin



Bayesian probability density estimates of model parameters, Maximum Sustainable Yield and Biomass obtained for the Surplus production model using time series data on catch and effort for Tamil Nadu.

During this year, efforts were made to finalise the possible prior distributions for the various Schaeferian parameters like carrying capacity (K), intrinsic rate of growth (r), Virgin Biomass (B_0) and catchability coefficient (f) which can be put to use for Bayesian studies. Repeated simulation exercises were attempted to compare and contrast the published values of these parameters and the outcomes thrown up by the various distributions. It was finalised that lognormal and inverse gamma distributions were the most suitable for prior distributional assumptions. The biomass time series and the effort time series were best represented by log normal distribution, whereas the various measures of spread of these parameters can be better served with inverse gamma distribution.

To study the suitability of various options, software which work based on the Markov Chain Monte Carlo (MCMC) algorithm of Gibb's Sampling were attempted. The OpenBugs, which is an open source effort to dish out MCMC based Bayesian analysis, was used to study the state-space models on various fisheries of India. The 15 year catch and effort data sets of Kerala, Tamil Nadu and West Bengal were analysed using OpenBugs with 10000 replications using a modified lognormal - inverse gamma combination. The posterior densities of important parameters were plotted and the results compared with the traditional estimates. The bootstrapped variances of the estimates were also obtained.

PROJECT CODE FRA/IDP/01
PROJECT TITLE **Sustainability profiling of major fisheries off Kerala coast - a multi dimensional scaling approach**
SCIENTISTS **J.Jayasankar,** E.Vivekanandan, R. Sathiadas, T.V. Sathianandan, P.T. Sarada, C. Ramachandran, Somy Kuriakose, V. P. Vipinkumar and Mini K.G.
CENTRE Cochin

This project envisages the usage of primary and secondary data with the aim of integrating various aspects of fishing and fishery towards arriving at an unique status on the sustainability of the fishery. The published macro and micro level quantitative as well as qualitative information

would be processed for arriving at an indication of the sustainability of the fisheries. The project plans to study the Kerala fisheries and it covers the different gamuts of fisheries like the gear, area and resources. The fisheries targeted are

(i) South, mid and North Kerala fisheries

(ii) Prawn/shrimp fishery and small pelagic fishery

(iii) Seine and trawl fisheries

(iv) Fisheries around major centres like Munambam, Cochin FH, Vypeen, Vizhinjam, Chombala, Pudiyappa, Sakthikulangara and Beypore.

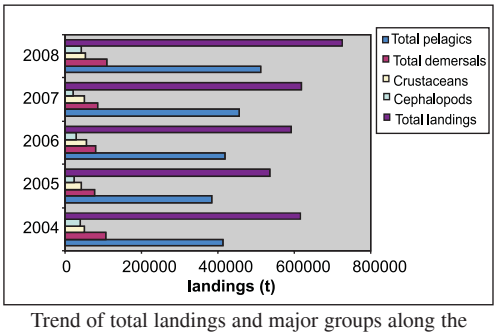
The proposed facets to be compared simultaneously are : Techno-biological, Economic, Social, Ecological and Ethical. The clientele are classified into three categories, viz. fishermen, market/ middle men and observers. The issues like code of conduct for responsible fisheries, social conflict etc. were studied in depth so as to be modified to suit to the preparation of questionnaires/ schedules. Fifteen to twenty major aspects under each of the five domains of sustainability observation have been finalised.

Towards having a preliminary opinion about the view of observers on the Kerala fishery, a Delphi sampling procedure was applied to ten field staff of FRAD who were posed with questions related to economic, social, ecological and technological aspects of the fishery. Their response clearly indicated the above normal performance on the technological front and a very poor performance on the ethical and social fronts. The sampling survey plan is being worked out on the basis of techno-social stratification of the stakeholders.

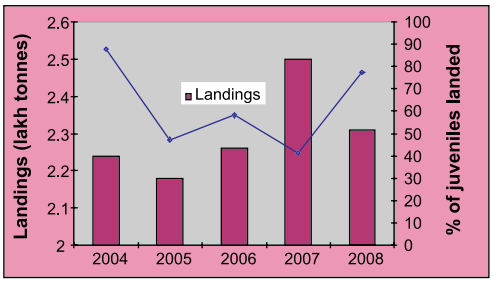
PROJECT CODE	**PEL/IDP/01**
PROJECT TITLE	**Management advisories for sustaining marine fisheries of Kerala and Lakshadweep**
SCIENTISTS	**N.G.K. Pillai,** E. Vivekanandan, Grace Mathew, E.V. Radhakrishnan, K.S. Mohamed, U. Ganga, E.M. Abdussamad, T.S.Velayudhan, Somy Kuriakose, Rekha Devi Chakraborthy, Lakshmi Pillai, C. Ramachandran, P.T. Sarada, P. Laxmilatha, P.N.R. Nair, M. Sivadas, P.P. Manoj Kumar, K.P. Said Koya, K.K. Philipose, S. Jasmine, M.K. Anil and K.N. Saleela
CENTRES	Cochin, Calicut and Vizhinjam

Trends in the marine fish landing in Kerala during 2008

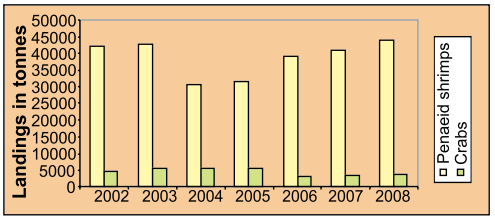
- The marine fish landings along the Kerala coast showed an increasing trend during the past few years with a record landing of 6.7 lakh tonnes (t) during 2008, which is an increase of 8% compared to 2007. Targeted fishing for resources such as cephalopods by trawls, anchovies by ring seine and oceanic tunas by gill net, hooks and line as well as deep sea trawlers with longlines were the contributing factors.
- Among the total landings, pelagics accounted for 71%, demersal 14%, crustaceans 8% and cephalopods formed 7 %.
- The highest landings was recorded during the III quarter (July to September) (37%), followed by IV quarter (Oct- Dec) (27%), I quarter (20%) (Jan-March) and II quarter (17%) (April-June).



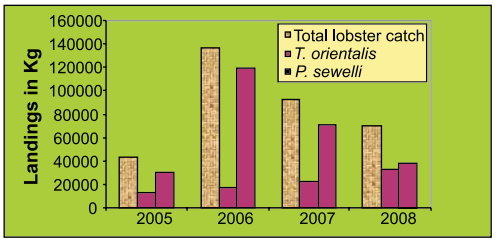
Trend of total landings and major groups along the Kerala coast (2004 - 08)



Total oil sardine landings and number of juveniles (percentage) caught along Kerala coast during 2004-08



Trends in penaeid shrimp and crab landings during 2002-2008



Lobster landings along Kerala coast during 2005-08

- The estimate of district-wise production showed that Alappuzha and Kozhikode districts contributed 17% each, followed by Ernakulam (15%), Kollam (14%), Malappuram (10%), Thrissur (9%), Trivandrum (8%); the rest (10%) was from the northern coastal districts of Kannur and Kasaragod.
- Compared to previous year, significant increase was been observed for molluscs (+48%) followed by demersals (+10%) and crustaceans (+8%). Pelagics landings showed only a nominal increase of 3%.
- Mechanized sector contributed 52%, motorized 46% and the rest was artisanal sector (2%). During the previous year, landings by motorized sector was dominant (3.42 lakh t).
- In the mechanized/motorized sector, ring seines (RS) contributed 51% of the total landings. This was 12% higher than the previous year and dominated by oil sardine, mackerel and small carangids mainly scads.
- Among the various gears, contribution by gillnet and hooks and line decreased to 12% from 16% during the previous year, while trawl contribution to total catches increased from 25 to 27%. The major resources appearing in gillnets such as oceanic sharks and tunas also occurred in multi-day trawl landings during 2008 as they were caught in the supplementary hooks and line gear employed by this fleet.
- Trawl landings (1.82 lakh t) increased by 20% (30,589 t) compared to previous year . Multiday trawls contributed 21% of the total landings compared to single day trawls (6%). Effort (in Actual Fishing Hours, AFH) increased by 28% in single day trawls, but declined marginally by 1% in multi-day trawls. Dominant resources were penaeid prawns, cephalopods, threadfin breams, ribbonfishes, lizardfishes, anchovies and elasmobranchs.
- Zooplankton feeders such as anchovies and lesser sardines as well as carnivorous fishes in the higher trophic level such as rock cods, snappers and sharks along with cephalopods showed increase in landings during 2008. During the previous year the increase in landings was mainly contributed by oil sardine, a phytoplankton feeder.
- **PELAGICS:** The average landings of pelagic resources along the Kerala coast for the past five years was 4.36 lakh t. Major resources contributing to the pelagics were oil sardine (54%), mackerel (13%), carangids (9%), anchovies (6%), tunas (5%), ribbonfish (4%), seerfishes and lesser sardines (2% each).
- During the year 2008, an estimated 4.7 lakh t of pelagic resources was landed. Compared to 2007, an increase was recorded in the landings of anchovies (67,793 t, +162%), lesser sardines (14,368 t, +132%) and seerfishes (10921 t, +12%); groups such as carangids (31510 t, -21%), tunas (20,188 t, -20%); ribbonfish (10,699 t, - 6%); mackerel (57,843 t, -15%) and oil sardine (2,31,636 t, -7%) showed decline in landings.
- The oil sardine *Sardinella longiceps* was the biggest contributor to the total marine fish landings of Kerala, intensively exploited using ringseines (86%), outboard gill nets (9%), boat seines (2%) and trawls (1%). Non-mechanised sector contributed only 2% of the sardine landings. Along the Malabar coast, 97% of the oil sardine landings

was by ring seine with peak landings during November and April. Size range in the fishery was 70-200 mm. Along the Central Kerala coast, juvenile component of the oil sardine catch in ring seines was very high with 78% being below length at first maturity (L_m). This was 37% more than 2007 and 10% less than that of 2004.

- The lesser sardine fishery was mainly supported by *Sardinella fimbriata* in the southern coastal districts and *S.gibbosa* in north Kerala. Ring seines and boat seines contributed 71% and 10% of the landings respectively, while the contribution by non-mechanised sector was also significant (15%).
- Anchovy (*Stolephorus* spp.) was landed in good quantities by ring seine units especially during May - July period. Major species were *S. commersonii* and *S. devisi* along the central and south Kerala region. Since adults contributed a major portion of the landings, exploitation was biologically sustainable as recruitment was ensured.
- Mackerel was landed mainly by ring seines (67%), outboard gill nets (21%) and trawls (5%). Along the Malabar coast mackerel of 95-290 mm size were caught with 160 and 220 mm size groups dominating the landings. There was good recruitment of juveniles during the year especially from July to September.
- Tuna fishery occurred round the year with peak during September-November. Eight species of tuna was recorded in the fishery, of which six contributed to commercial fishery. The coastal tunas such as *Euthynnus affinis* (65%) and *Auxis* spp. (12%) dominated the landings along the Kerala coast, while oceanic species such as yellowfin and skipjack contributed 17% and 3% respectively and the neretic species *Thunnus tonggol* contributed 2%. Young ones of coastal tunas (*E.affinis*, *Auxis* spp.) were observed in the landings round the year, with peak abundance during June to September.
- At Cochin, yellowfin tuna *Thunnus albacares* dominated the tuna catch in DGN and hooks and line (H&L) by contributing 57% and 62 % respectively while *Katsuwonus pelamis* formed about 26 % in both gears. Among coastal tunas, *E. affinis* and *A.thazard* dominated the catch. Other species observed in the landings were *Auxis rochei*, *T. tonggol*, *Sarda orientalis* and *Gymnosarda unicolor*.
- The size range of *T.albacares* in the fishery was 60-180 cm. (modes 92-96), while for *E.affinis, A.thazard* and *K.pelamis* it was 36 – 58 cm (mode 44, 46 cm), 32 - 42 cm (mode 32 and 36 cm) and 40-82 cm (major mode 60 and 64 cm) respectively.
- Billfish was landed as by-catch in H & L and drift gill net (DGN) units and represented by species such as *Istiphorus platypterus*, *Makaira* spp. and *Xiphias* spp.
- Carangid fishery occurred round the year with peak landings during September-October in the central and southern districts along the Kerala coast. Fishery was supported by 38 species, of which 12 were at commercial level. Young ones of several species were encountered in the landings round the year, with peak period being south west monsoon. In trawler landings, *Decapterus* spp. followed by *Selar crumenophthalmus* dominated, while in gillnets, *Megalaspis cordyla, C. ignobilis*, *C. sexfasciatus* and *Elagatis bipinnulatus* dominated.

Bumper catch of oil sardine at Kochi

Landing of juvenile seerfishes by ring seines at Kalamukku landing centre

Landing of Cobia in drift gill nets at Cochin Fisheries Harbour

- Ribbonfish fishery was supported by a single species, *Trichiurus lepturus.* Size in the trawl fishery at Kochi was 40-93 cm with mean size of 69 cm, while at Neendakara it was 54-85 cm with mean size 70 cm.
- At Cochin, seerfish *Scomberomorus commerson* was landed mainly in gillnets (67%) followed by ring seines (5%), hooks and line (23%) and trawl (5%). The entire catch in trawls and ring seine and 46 % of the catch in DGN was constituted by immature fishes. Size range was 43-90 cm in DGN & H & L, while in the trawls it was 26-48 cm. (with major mode at 32 cm.). Exploitation rate (E) was relatively high at 0.7**.**
- Cobia (*Rachycentron canadum*) occurred as a high value by-catch in trawls, DGN and H&L with peak landings during August- September period at Cochin. Size range of Cobia landed was 30 - 170 cm fork length (FL); large sized fishes dominated the GN and H & L landings, while fishes with FL < 70 cm dominated trawler landings.
- The increase in fishing effort by inboard ring seine units has not resulted in any increase in the catch of small pelagics such as oil sardine and mackerel, but the number of juveniles of oil sardine caught in this gear has increased compared to last year. However, juveniles of several large pelagics such as seerfishes, coastal tunas and carangids were landed in this gear which is an undesirable trend and therefore needs monitoring.

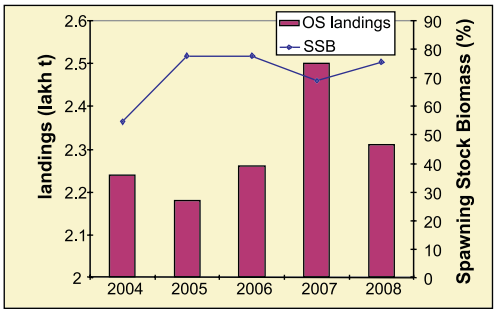
Fishery related parameters of some important pelagic resources

Species	Length range (mm)	Fishery dominant size group (mm)	Exploitation ratio (E)	Length at first capture (mm)	Length at first maturity (mm)
S.longiceps	70-200	140 -200	0.8	151	140
R.kanagurta	90-290	110-270	0.6	130	175
S.commersonii	60-140	60-100	0.5	65	75
E.devisi	60-90	70-90	0.5	65	65
E.affinis	360 -580	450 - 600	0.7	400	430
K.pelamis	400- 820	420 -660	0.6	440	440
T.albacares	600-1800	700 -1200	0.5	720	780
D.russelli	150-225	180 -240	0.2	17	170
M.cordyla	205 -405	220-330	0.6	22	208
T.lepturus	400 - 930	700-850	0.6	49	418
S.commerson	460-900	600 - 800	0.8	51	710

- **DEMERSALS:** During 2008, an estimated 96,137 t of demersal fishes was landed with threadfin breams (30554 t), lizardfishes (10521 t) and sciaenids (10548 t) being the major resources, while elasmobranchs comprised only 4048 t. Landings of elasmobranchs, lizardfishes, rockcods, snappers and threadfin breams increased, while sole, silverbellies and goatfish landings declined compared to previous year.
- The annual contribution of elasmobranchs for the past three years showed that there was very good improvement in the fishery, especially in trawls. The contribution of sharks, rays and skates to the fishery

was 61.8, 9.1 and 29.1% respectively. Nineteen species of sharks and rays were found in the fishery including *Carcharhinus limbatus*, *C. sorrah*, *Alopias vulpinus*, *Sphyrna zygaena*, *C. amblyrhynchoides*, C. *melanopterus*, *Rhizoprionodon acutus*, *C. falciformis*, *Isurus oxyrhynchus*, *C. brevipinna*, *C. leucas*, *S. lewini*, *Rhizoprionodon oligolinx*, and *Galeocerdo cuvieri*. Among rays, species such as *Aetobatus narinari*, *Himantura uarnak, Dasyatis bleekeri* and *Mobula* sp. were observed in the fishery.

- The spawning stock biomass estimated for *C. limbatus* along Kerala coast was 31% of the annual stock at its unexploited level which shows that the resource is having sufficient regeneration capacity.
- The threadfin bream landings in Kerala showed an increase of 9% against 2007. *Nemipterus mesoprion* (54%) was the dominant species in the fishery followed by *N. japonicus* (44%), *N. tolu* (1.6%) and *Parascolopsis aspinosa* (0.4%). *P. aspinosa* was found in the fishery during August- October. The spawning stock biomass of *N. mesoprion* and *N. japonicus* was more than 40% and 45% respectively at its unexploited level.
- The total flatfish landing along the Kerala coast which showed a decline of 38% compared to previous year was mainly landed in trawls (92%) followed by gillnet (4%), ring seine (1%) and non-mechanized sector (3%). *C. macrostomus* (81%) was the dominant species found in the fishery followed by *C. dubius* (8%), C. *arel* (9%) and others (2%). The spawning stock biomass was estimated at more than 40 % of the annual stock at its unexploited level.
- Sciaenid landings (10548 t) in Kerala comprised of ten species of which *Johnieops sina* (57.3%) was the dominant species in all the gears. Other species were *Otolithes ruber* (11.4%), *Johnius glaucus* (10.3%), *J. macropterus* (7.2%), *J. belangeri* (5.8%), *O. cuvieri* (5.4%), *J. vogleri* (0.8%), *J. dussumieri* (0.7%), *J. carutta* (0.7%) and *J. elongatus* (0.4%).The estimated exploitation rate for *J. sina* and *O. ruber* is 0.7 indicating that the fishing pressure on these resources is very high. However the spawning stock biomass estimated for both the species is more than 30 % of the resource at its unexploited level which is a good indicator of the regeneration capacity of the resource.



Spawning Stock Biomass (%) of total standing stock and catch trend of oil sardine along Kerala coast during 2004 - 2008

Landing of scads at Calicut Fisheries Harbour

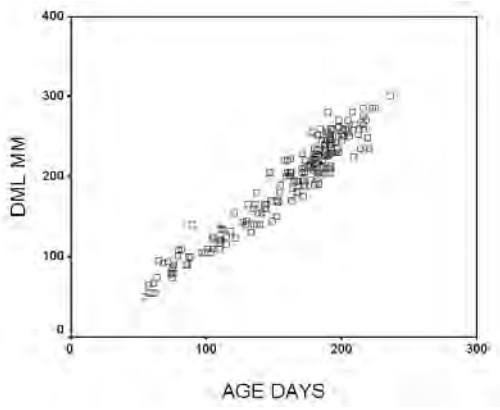
Landing of sciaenids at Calicut

Fishery related parameters of some important demersal resources

Species	Length range (mm)	Mean size (mm)	Fishery dominant size group (mm)	Exploitation rate (E)	Spawning stock biomass (t)	Standing stock biomass (t)
C. limbatus	524-2424	1179.6	900-2000	0.75	1335	2283
N. mesoprion	22-288	113.75	120-160	0.58	23899	30142
N. japonicus	32-348	139.39	150-200	0.60	23985	27695
C. macrostomus	32-164	98.4	90-140	0.45	4578	9165
J. sina	22-218	127.2	90-150	0.70	3237	7190
O. ruber	82-348	175.4	130-220	0.72	465	573

- **CRUSTACEANS**: An estimated 56,449 t was landed of which penaeid shrimps was the most important resource (42,369 t); landings showed an increase of 3% compared to previous year. Non-penaeid

Landings of deep sea shrimps from multi-day trawlers at Neendakara Fisheries Harbour



Ageing of cuttlefish *S. pharaonis* using hard parts

Landings of Green mussel at Calicut

component declined by 32%, while stomatopods (5890 t) increased threefold. Crab landings also increased by 11% compared to previous year.

- An average of 21079 kg of *Thenus orientalis* and 64565 kg of the deep sea lobster *Puerulus sewelli* was landed at Sakthikulangara Fisheries Harbour during 2005-08. Landing of *T. orientalis* showed an increasing trend from 13106 kg in 2005 to 32316 kg in 2008. Peak landing of *P. sewelli* was in 2006 (120 t) and the least was in 2005 (30 t).
- During 2002-08, the average penaeid shrimp landing along Kerala coast was 38750 t with maximum landing recorded in 2008 (44065 t) and the minimum in 2004 (30577 t). The average crab landing was 4532 t with maximum (5506 t) in 2004 and minimum (3079 t) in 2006.
- The inshore shrimp fishery along the Kerala coast was supported mainly by *Metapenaeus dobsoni, Parapenaeopsis stylifera, Fenneropenaeus indicus, M. monoceros* and *M. affinis* with *Penaeus semisulcatus*, *P. monodon* and *P. Longipes* landed in minor quantity.
- Among the deep sea shrimps, pandalids constituted 56% and penaeids (44%). Pandalid shrimp *Plesionika spinipes* (24%) was the dominant species, others being *Heterocarpus gibbosus* (15%) and *H. woodmasoni* (14%). The penaeids, *Metapenaeopsis andamanensis* (26%) and *Aristeus alcockii* (16%) were the important constituents, while species such as *Parapenaeus jerryi* and *Solenocera hextii* contributed 1% each.
- The mean size of *M. dobsoni* and *P. stylifera* landed in Cochin did not show much variation over the years, except for a slight reduction in the mean size of *P. stylifera*, 74 mm for females and 69 mm for males during 2008 compared to 93 and 73 mm respectively in 2005.
- *Charybdis feriatus, Portunus sanguinolentus* and *P. pelagicus* are the major species of crabs landed. Besides these species, *C. lucifera* was also landed during November-December.
- The mean size of *P. pelagicus* landed in Cochin has decreased after 2005, whereas in the case of the dominant species, *P. sanguinolentus* the mean size has increased during 2005-07.
- **MOLLUSCS:** Landings of Cephalopod increased by 93% (23,391 t) compared to previous year. An estimated 46,199 t of cephalopods landed was mainly constituted by squids (56%), cuttlefishes (33%) and octopus (6%).
- Among cuttlefishes, *Sepia pharaonis* dominated (88%) followed by *S. prashadi* (2.6%). Among squids, *Loligo duvauceli* contributed 58% followed by *D. singhalensis* 23% and *D. sibogae* with 17%. Octopus fishery was supported by *O. membranaceous* (58%) and *O. dollfusi* (31%).
- *D. singhalensis* and *D. sibogae* were present throughout the year. H&L landed bigger sized *S. pharaonis* and the oceanic squid *S. oualaniensis* recorded its presence in jigs.

- The One increment – One day hypothesis was tested using the cuttlebone of the pharaoh cuttlefish *Sepia pharaonis* and indicated a very fast growth pattern for the species.
- Gastropod fishery in Kerala registered an overall increase in the landings. The species composition of landings at Quilon was *Babylonia* spp.(54.5%), *Bursa* spp.(12.3%), *Murex* spp. (10.2%), *Tibia* spp. (4.1%), *Xancus pyrum* (2.6%), *Strombus* spp. (1.55%), *Fusinus* spp. (4.2%) and *Turriculas* spp.(1%)

Marine fish landing trends in Lakshadweep

- The estimated total fish catch from Lakshadweep waters during 2008 was 10852 t of which tunas constituted 73 % (7908 t) and other fishes formed 27 %. The contribution by tuna to the total fish catch of Lakshadweep has shown a declining trend from 78 to 73 % during the last five years.
- The tuna fishery was comparatively better in the northern islands of Agatti and Androth, but was poor at Minicoy. Pole & line was the major gear employed in tuna fishing (93%) followed by troll line (5%), drift gill net and hand line (2%). Skipjack *K. pelamis* formed about 84 % of the tuna catch followed by yellowfin *T. albacares* (13%), little tunny *E. affinis* (2%) and frigate tuna *A. thazard* (1%). Dogtooth tuna *G. unicolor* was occasionally landed.
- At Androth, fishing using DGN yielded very good catches of medium size yellowfin tunas in August (7.3t). Hand lining during November and December at Minicoy also yielded good yellowfin tuna catches.
- The pole & line fishing units at Minicoy and Agatti experienced acute live bait shortage during November to January, indicating urgent need for sustainable management of live bait resources as well as deployment of alternate livebait species.
- The OBM monsoon fishery particularly the hand line fishery at Minicoy and the hand line and gill net fishery at Androth were adversely affected due to the kerosene shortage.
- The smoke-dried *Mas* registered record price of Rs. 265/ kg.

Fisheries Management Advisories

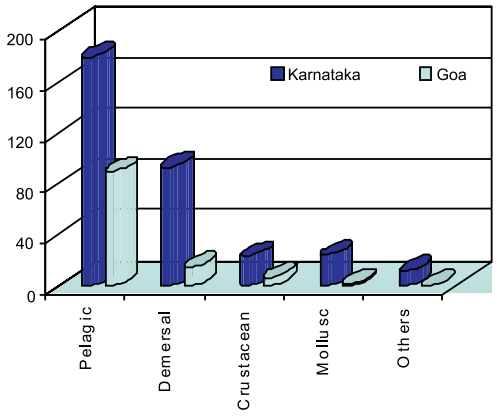
The redundant "steppney units" and additional 100 units (Suhali 25, Bitra 20, Agatti and Kadmat 10 each, Androtl, Amini, Chetlat, Kalpeni, Kavaratti, Kiltan and Minicoy 5 each) may be deployed as dory fishing units for the augmentation of tuna production by about 2500-3000 t / year. Immediate dissemination of PFZ forecast (for surface tunas) through 'Fisheries Communication Network' and the effective deployment of the units can aid reduction of the scouting time and fuel consumption and an increase in tuna catch. Diversification of some fishing effort towards reef fishes, carangids, needle fishes, flying fishes, half beaks etc. are recommended. Establishment of Sport /Game fishing tourism centres in selected islands for employment generation through tourism promotion. may also be done.

Yellowfin tuna

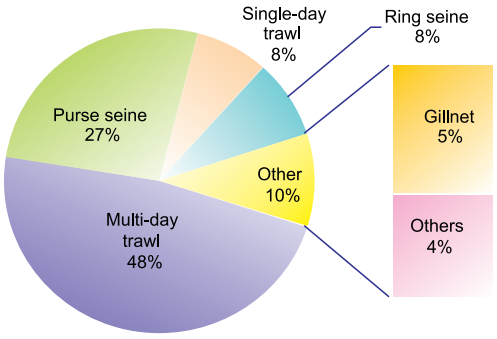
Management options

- The Maximum Sustainable Yield for Kerala has been estimated at 6.99 lakh t. Optimum fleet size of outboard ring seines has been estimated at 353 to 816 units and effort regulation at an optimum of 29,05,091 hours of operation by multiday trawl fleet and 20,41,786 hours by single day trawlers is recommended.
- The strong negative correlation (r^2=0.7) between the numbers of juvenile sardine landed and oil sardine catches of the following year indicate that inspite of the high fecundity of oil sardine, large scale capture of juveniles, especially by large ring seine units is risky and unsustainable in the long run. The resource is being sustained mainly because, under the present favourable environmental conditions, the spawning population is ensuring the recruitment to the fishery.
- Fishing of juvenile seerfishes by trawls and ringseines should be avoided to ensure that growth overfishing does not occur and yield is maximized from the fishery.
- Further increase in trawl effort is not recommended as it is likely to affect the spawning stock biomass levels of major crustacean resources such as penaeid prawns and crabs to below optimum levels for efficient recruitment to the fishery

PROJECT CODE	**PEL/IDP/02**
PROJECT TITLE	**Management advisories for sustaining marine fisheries of Karnataka and Goa**
SCIENTISTS	**A.P. Dineshbabu,** Geetha Sasikumar, P.S. Swathi Lekshmi and K.G. Mini
CENTRES	Mangalore and Cochin



Catch composition by different gears in Karnataka and Goa during 2008



Gearwise catch contribution in Karnataka during 2008

Shore seine catch in Karnataka

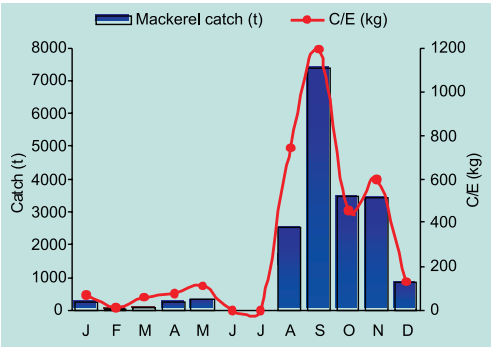
- The marine fish landings of Karnataka during 2008 was 3,29,401 t which showed a 13% increase as compared to 2,91,813 t recorded in 2007. In Goa**,** 13.7% increase was recorded compared to 97,160 t (2007).
- In Karnataka major gears contributing to the catch are multiday trawl (MDT) (48%, C/hr: 45.5 kg/hr), purseseine (27%, C/E: 2,060 kg/unit), singleday trawl (SDT) (7.7%, C/hr 36.06 kg), gillnet (5.4%) and other gears (12.5%). The catch (11.65%), effort (21%) and CPUE (11.8%) by purse seine showed a decreasing trend.
- The landing by SDT was 25,425 t, catch rate was 36.1 kg/hr; SDT contributed 7.7% to the marine fish production of the state. Shrimps (18.4%), crabs (3.3%), soles (11%), silverbellies (5.4%), croakers (3.6%), ribbonfish (3.4%) and oil sardine (3.2%) were the major species in the gear. In multiday trawls, major groups were threadfin breams (21.9%), lizard fish (10.8%), perches (7.2%), ribbon fish (11.9%), cephalopods (14.6%) and penaeid prawns (2.8%).
- Small meshed gillnets landed 17,896 t fish which was constituted mainly by Indian mackerel, penaeid prawns, croakers, *Thryssa* spp., oil sardine, carangids. In big meshed gillnets, seerfish, tunas, shark etc were caught. Other gears (*yendi*, *kairampani* (shore seines), cast net) landed 471,019 t; major groups were oil sardine, Indian mackerel, croakers, carangids, other clupeoids, silverbellies, shrimps and crabs.
- In Goa**,** purse seine fishing is most popular and the annual production by the gear was 79,630 t which formed 72.1% of the total marine production of the State. The catch showed an increasing trend (6.2%) but effort (2.8%) and CPUE (9.03%) showed a decreasing trend.
- SDT landed 3,609 t in Goa with a catch rate of 18.7 kg/hr and contributed 3.3% to the marine fish production. Shrimps (41.7%), crabs (11.5%), soles (5.8%), croakers (7.2%), silverbellies (4.2%), ribbonfish (2.8%), etc. formed the major groups. Multiday trawls with a catch rate of 41.8 kg/hr landed 12,422 t contributing 11.2% to the marine fish production. The catch was constituted by threadfin breams (48.5%), perches (22.0%), ribbon fish (10.1%), cephalopods (9.8%) and penaeid prawns (3.1%).
- Gillnets landed 3,610 t fishes and contributed 3.3% of the total landings of Goa. Indian mackerel, penaeid prawns, croakers, *Thryssa* spp., oil sardine, carangids etc. were the major groups landed. Other gears landed 11,237 t fish (10.2% of the total production). Oil sardine, Indian mackerel, croakers, carangids, other clupeoids, silverbellies, shrimps and crabs form the major catch in the gear.

Marine fish catch (t), catch composition (%), trend in production for Karnataka, 2008

Species	Catch 2008	% in all-fish	Catch 2007	Trend (%)(+/-)	Value (Rs in lakhs)
Oilsardine	78051	23.7	94849	-17.7	6244.1
Lessersardine	8405	2.6	5330	57.7	1260.8
Stolephorus sp.	3164	1	2884	9.7	791
Carangids	16979	5.2	7887	115.3	3956.4
Mackerel	31089	9.4	45222	-31.3	10881.2
Ribbonfish	20450	6.2	15120	35.3	4090
Seerfish	7168	2.2	4000	79.2	9441.2
Tunas & billfishes	2777	0.8	842	229.8	920.6
Threadfin breams	34651	10.5	20468	69.3	8662.8
Whitefish	2221	0.7	2681	-17.2	888.4
Flatfish	4824	1.5	6600	-26.9	1447.2
Silverbellies	5164	1.6	3851	34.1	258.2
Pomfrets	808	0.2	404	100	969.6
Elasmobranchs	949	0.3	740	28.2	467.7
Shrimps	10359	3.1	13895	-25.4	12375.5
Crabs	1945	0.6	2511	-22.5	778
Squilla	10438	3.2	17493	-40.3	208.8
Cephalopods	23647	7.2	10072	134.8	12448.8
Others	66312	20.1	36964	79.4	8234.9
Total	329401	100.1	291813	12.9	84325.2

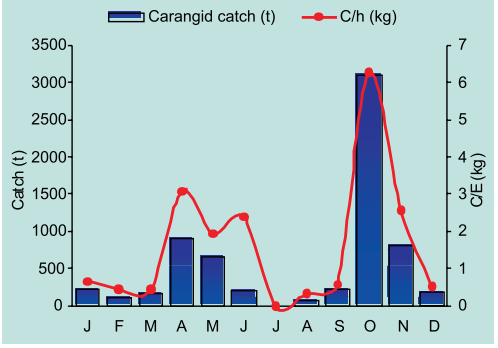
Marine fish catch (t), catch composition (%), trend in production for Goa, 2008

Species	Catch 2008	% in all-fish	Catch 2007	Trend (%)(+/-)	Value (Rs in lakhs)
Oilsardine	49123	44.5	47712	3	3929.8
Lessersardine	4015	3.6	2562	56.7	602.3
Stolephorus sp.	0	0	8	-100	0
Carangids	6644	6	5807	14.4	590.9
Mackerel	23735	21.5	19153	23.9	8307.3
Ribbonfish	1452	1.3	1996	-27.3	290.4
Seerfish	560	0.5	1383	-59.5	551.8
Tunas & billfishes	2276	2.1	3493	-34.8	569
Threadfin breams	6021	5.4	369	1531.7	1505.3
Whitefish	192	0.2	155	23.9	76.8
Flatfish	211	0.2	1467	-85.6	63.3
Silverbellies	822	0.7	2164	-62	41.1
Pomfrets	83	0.1	106	-21.7	99.6
Elasmobranchs	47	0	676	-93	18.2
Shrimps	4508	4.1	899	401.4	5409.6
Crabs	501	0.5	347	44.4	200.4
Squilla	677	0.6	159	325.8	13.5
Cephalopods	1310	1.2	200	555	685.15
Others	8331	7.5	8504	-2	1936.5
Total	110508	100	97160	13.7	24891.0



Average monthly production of mackerel at Karnataka during 2008

A view of fishmarket in Goa



Average monthly production of carangids at Karnataka during 2008

Anchovies landed at Karnataka

Length range, mean-size and length at maturity (L_m) of major pelagic species

Species	Gear	Length range (cm)	Mean size	L_m
R. kanagurta	Purseseine	15-28.0	21.4	17.5
	Trawl	8.5-28.5	22.0	
S. longiceps	Purseseine	9.0-20.5	14.0	15.0
	Trawl	10.0-20.5	17.5	
	Ringseine	14.0-20.0	17.9	
E. devisi	Purseseine	5.2-9.4	7.2	6.8
	Trawl	4.6-9.8	8.2	
S. waitei	Trawl	5.8-11.6	8.4	8.0
M. cordyla	Drift-gillnet	18.0-44.0	34.5	23
	Trawl	13.0-41.0	23.1	
D. russelli	Trawl	10.0-25.0	20.5	14.5
S. commerson	Drift gillnet	36-112	67	70
	Trawl	12-80	47	
E. affinis	Drift gillnet	16-68	41	43
A. thazard	Drift gillnet	22-48	39	30.5
T. lepturus	Trawl	22-110	62	60

Ring seine landings in Karnataka

Growth and mortality parameters of major pelagic species of Karnataka

Species/Parameters	L_∞ (cm)	K	Z	M	F	E
R. kanagurta	31.8	1.1	8.63	2.10	6.53	0.76
S. longiceps	22.8	0.9	5.71	2.81	2.90	0.51
E. devisi	11.7	1.59	15.74	2.81	12.93	0.82
S. waitei	11.5	1.5	6.10	2.67	3.43	0.56
M. cordyla	49.6	0.7	2.48	1.49	0.99	0.40
S. commerson	162	0.78	9.09	1.61	7.48	0.82
D. russelli	28.4	0.7	6.55	1.49	5.06	0.77
E. affinis	79	0.89	4.77	1.78	2.99	0.63
A. thazard	49	0.96	2.98	1.88	1.10	0.37
T. lepturus	134	0.82	6.03	1.73	4.30	0.71

- Among demersal resources, threadfin breams dominated the catch and was represented by *N. mesoprion* (81%) and *N. japonicus* (19 %). Mean size in the fishery was 14.3 mm and 16.2 cm respectively as against the L_m of 17.2 cm and 18.8 cm respectively.
- The whitefish fishery was supported by fishes with a mean size of 14.9 cm as compared to the L_m of 13.2 cm.
- Sole fishery was supported by five species, dominated by *C. macrostomus*. Mean size in the catch was 13.3 cm as against the L_m of 11.5 cm.

Sole landings in Karnataka

Growth and mortality parameters of major demersal finfish species of Karnataka

Species/Parameters	L_∞ (cm)	K	Z	M	F	E
N. mesoprion	31	0.78	4.52	1.61	2.91	0.84
N. japonicus	33.5	0.89	3.24	1.78	1.46	0.45
C. macrostomus	17.8	0.95	6.70	1.86	4.84	0.72
L. lactarius	29	1.0	4.84	1.94	2.90	0.60

- Shrimp were landed mainly by trawlers in Karnataka and Goa. Among 11 species, *M. monoceros* (40 %) was the most dominant species in Karnataka, with an annual landing of 4,150 t.

Growth and mortality parameters of major shrimp species of Karnataka

Species	L_∞ (cm)	K	Z	M	F	E
M.dobsoni	11.9	1.2	3.82	2.23	1.59	0.42
M. monoceros	12.3	1.5	5.40	2.23	3.17	0.59
P. stylifera	19.2	1.4	5.96	2.76	3.20	0.54
S. choprai	12.0	1.2	5.33	2.20	3.13	0.59

- Out of the three edible species of crabs landed, *Portunus sanguinolentus* (49%) was the most dominant species with an estimated landings of 1,127 t in Karnataka and 158 t in Goa.

Species	L_∞ cm)	K	Z	M	F	E
P.sanguinolentus	16.9	1.9	4.21	2.20	2.01	0.48
P.pelagicus	17.3	1.3	5.78	2.20	3.58	0.60
C.feriatus	13.5	1.2	5.83	2.20	3.63	0.62

- The cephalopod fishery of Karnataka was supported by squid *Loligo duvauceli*, cuttlefish, *Sepia pharaonis* and octopus *Octopus membranaceous. L. duvauceli* and *S. pharaonis* were the dominant species in Goa.

- *S. pharaonis* fishery was supported by 30 - 390 mm specimens with a mean size of 203 mm and *L. duvauceli* by 20 - 380 mm with a mean size of 136 mm.

- Growth, seasonal recruitment and migration patterns of *S. pharaonis* were studied based on the observations of commercial landings during 2002-2006. Negative allometric growth in weight with length was observed for males and females and biometric relationships were estimated.

- Analysis of the size-composition patterns discriminated two pulses in recruitment to the *S. pharaonis* fishery, discernible by a decrease in the monthly mean size of the population. The first cohort, (post-monsoon cohort) which supports the major fishery, was composed of medium-sized, fast growing, early maturing individuals, whereas, the second cohort (pre-monsoon cohort), comprised of slow growing, late maturing and large-sized individuals.

- The Schaefer model was fitted to cephalopod catch and effort data of MDT. The parameter estimates, *K (*carrying capacity*), r* (intrinsic rate of population growth) and *q (*catchability coefficient*)*, were 93,677 t, 0.403 per year and 8.614E-08 respectively.

- Status of exploitation of species along Karnataka coast in 2008 indicated that out of 24 species studied, 12 were exploited above optimum ($E \geq 0.6$) level.

Trawlers in Malpe fisheries harbour

Management advisories on status of the effort level in different fishing units on the basis of catch and effort studies (CEDA) for the period, 2002-08.

- *Effort reduction in Multi-day trawlers*

  F_{MSY} for the period was calculated at 22,79,159 hours. Effort in 2008 was 34,32,306 hours, which indicated that effort should be reduced by 33% for sustaining the population. While considering the reduction of effort in terms of units, standardization of unit in terms of engine capacity, endurance in sea and fish holding capacity etc. are to be taken care before suggesting policies.

- *Effort reduction in Purse-seine fishery*

  F_{MSY} for the resources exploited by purse-seine during 2000-2006 was calculated at 38,107 units, which shows that the fishing units should be reduced by 19% from the effort expended in 2006 (46,868 units) to reach at MSY level. However, unprecedented sardine landing during 2007-2008 made the results inconclusive for the last two years.

- *Effort retention in Gillnet*

  F_{MSY} for the period was calculated at 40,720 units. Average effort in 2002- 2008 was 41, 505 units which indicate that gillnet units can be retained at present level. The recent trends of multi-day gillnetting and reduction of mesh size from conventional gillnets, especially those targeting the seerfish, need a more closer monitoring, while advocating effort reduction.

- *Effort retention in Single day trawlers*

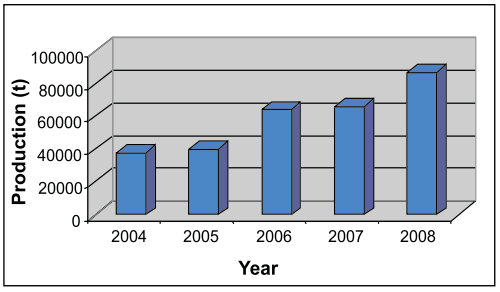
  Number of single day trawlers are being phased out and are being substituted by MDT, F_{MSY} for the period was calculated for SDF was 8,50,159 hours. Average effort in 2002 - 2008 was 7,93,217 hours which indicated that SDF units can be retained at the present level or even increased up to 20% only if the MDF is reduced by 33%.

PROJECT CODE	**PEL/IDP/03**
PROJECT TITLE	**Strategies for sustaining tuna fisheries along the coast of India**
SCIENTISTS	**E.M. Abdussamad,** N.G.K. Pillai, K.K. Vijayan, Srinivasa Raghavan, Pratibha Rohit, K.K. Joshi and Shubhadeep Gosh
CENTRES	Cochin, Visakhapatnam, Tuticorin and Veraval

- Tuna production along the mainland during 2004-08 registered continuous increase from 38,011 t (2004) to an all time high of 87,100 t by 2008.
- Annual growth rate of tuna catch was 5 % in 2005, 60.3% in 2006, 3.5% in 2007 and 28% in 2008. Coastal tuna production registered 23.2 % and oceanic tunas 38.5 % growth in 2008. Contribution of tunas to total marine fish catch also increased from 1.5% (2004) to 2.7% (2008).
- Resource was exploited mainly by gillnet (51%), followed by H & L (15.1%), trawl (7.2%) and other gears like bagnets, purseines, ring seines, etc (26.7 %). Effort expended by GN and H & L declined during 2008, production and catch rate by all gears, except hooks & line improved.
- The landings of oceanic species (*K. pelamis* and *T. albacares*) showed general increasing trend reflecting changes in fishing pattern across the mainland. The increase in production can be attributed to targeted fishing of oceanic tuna by traditional and mechanised sector during the recent years.
- Southwest coast contributed 37% of the tuna catch during 2008 followed by northwest 31%, southeast 26.3% and the rest by northeast region.

Tuna landings during 2008

- Fishery was supported by eight species; six at commercial level and others as incidental catch. Coastal tuna represent 66.4% & oceanic 33.6%. *Euthynnus affinis* dominated the catch (46.7%) followed by *T. albacares* (18.8%), *Katsuwonus pelamis* (14.5%), *Auxis* spp. (10.6%) and *Thunnus tonggol* (9.2%).
- Yellowfin landed along the Gulf of Mannar coast was relatively small in size compared to those landed at the Visakhapatnam and Kochi.
- Coastal tunas landed by trawls were mainly immature, below 5 months old.

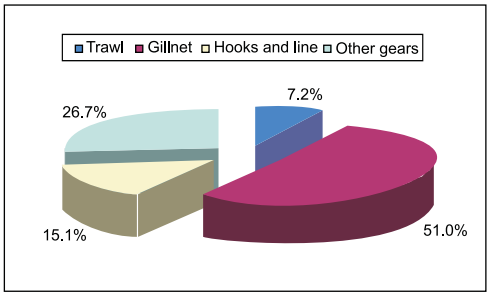


All India annual production of tuna (in tonnes) during 2004-08

Spawning season of tunas at different regions along the Indian coast

Species	NW	SW	SE
T. tonggol	Jan-April	-	-
K. pelamis	Jan-May	Aug- November	August-November
A.thazard	Round the year	August-April	March-May
E.affinis	Round the year	April-September	February-May
S.orientalis	Feb-May	February-March	March-May

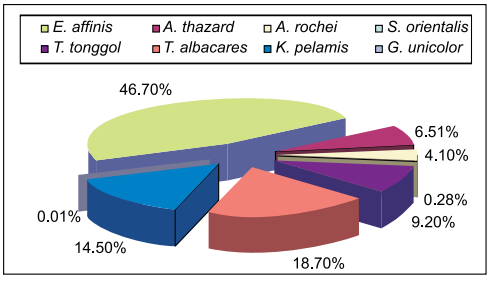
- Preliminary stock assessment indicated that coastal tuna production is very close to MSY level at many centres. More than 88% of the coastal tuna potential is exploited. However, only less than 15% of the oceanic tuna potential is currently exploited and hence have considerable scope for enhancing their production.
- Bar coding of six species of tunas collected from south west region has been standardized.



Gear-wise production of tuna during 2008

Management options

- Coastal tuna production at intensely exploited areas like Tuticorin and Cochin almost reached or even crossed optimum level. But on an all India basis, marginal scope remains for improving their production from under-exploited areas. Such areas have to be identified, more effort should be put to exploit the stock optionally.
- Effort required to exploit the oceanic tuna resources have to be determined based on the MSY and capability of the existing fishing units. Accordingly, excess shrimp trawl units currently operating in coastal waters have to be modified/upgraded for undertaking oceanic tuna long line fishing or wherever necessary additional efforts have to be introduced.



Species-wise production of tuna during 2008

PROJECT CODE CF/IDP/01
PROJECT TITLE **Management advisories for sustaining marine fisheries of Maharashtra**
SCIENTISTS **V.D. Deshmukh,** M.Z. Khan, S.G. Raje, Paramita Banerjee Sawant, Somy Kuriakose and V.P. Vipinkumar
CENTRES Mumbai and Kochi

- The estimated marine fish landings in Maharashtra was 3.58 lakh tonnes during 2008. The catch recorded 12.3% increase over last year's landings of 3.19 lakh t.
- The pelagic finfishes constituted 33%, demersal fishes 25%, crustaceans 34% and molluscs 8% of the total landings.

- Among the resources non-penaeid shrimps (19.8%), penaeid shrimps (13.1%), croakers (8.4%) and Bombay duck (7.3%) formed the major components of the landings. The catch of tuna and bill fishes, non-penaeid shrimps, lizard fishes, threadfin breams, carangids, cephalopods recorded was 94, 86, 41, 35, 31 and 29% respectively and showed increase, while sardines (66.7%), eels (34.2%), rock cod (37.1%), mackerel (25%) and lobster (94%) recorded significant decline.
- **Trawl fishery:** The shrimp trawl was the major gear that contributed 1.69 lakh t (47.1%) to the total marine fish landings. Penaeid prawns (21.8%), croakers (15%), cephalopods (10.5%), threadfin breams (9.8%), ribbonfishes (8.2%), Bombay duck (4.6%) and elasmobranchs (2.7%) formed bulk of the trawl catch.
- **Dol net fishery**: The *dol* net fishery was studied from Sasoon docks, New Ferry Wharf, Arnala and Vasai. The *dol* nets landed 1.09 lakh t of fish in the state with the catch rate of 37.8 kg/hr.
- **Gill net fishery**: The gill nets of varying mesh sizes (from 20-140 mm mesh) and dimensions together landed 47,090 t of fish by expending 3,35,686 boat trips at the catch rate of 140.3 kg/trip.
- **Purse seine fishery:** Purse seiners based at Ratnagiri and Mumbai landed 17,277 t of fish by the operation of 7,497 trips at the catch rate of 2,305 kg/trip.

Landing of Bombayduck at Mumbai

Landing of juvenile pomfrets at Mumbai

Resource-wise investigations

- ***Bombayduck*:** Estimated landing was 26,098 t of which *dol* nets contributed 65% and trawlers 29%. The catch rate of Bombay duck in '*dol*' nets (6.7 kg/haul) operated from Arnala improved by 16% while in trawlers (1.8 kg/hr) at NFW, it was 21%. Bombay duck landed by '*dol*' nets had a size range of 45-344 mm with annual mean of 169 mm while in trawlers it was 45-377 with mean of 206 mm.
- ***Golden anchovy*:** 11,391 t of *Coilia dussumieri* was landed in Maharashtra of which 46% was contributed by trawlers, 42% by *dol* nets and 9% by smaller *disco* gill nets. Annual spawning stock biomass was 4,879 t which formed 41.6% of standing stock biomass of 11,720t.
- ***Ribbonfish*:** An estimated 16,083 t of ribbon fishes was landed of which 14,600 t (91%) was contributed by trawlers and 1,098 t by *dol* nets recording 4.3% decline over the previous year. Spawning stock biomass was 8,387 t which formed 66% of the standing stock biomass of 12,635 t of the species.
- ***Oil sardine***: An estimated 9,954 t of oil sardine was landed which showed 67% decline when compared to 2007. Purse seine (49%) and trawl nets (16%) and smaller gill nets were the major gears.
- ***Seer fishes*:** A total of 9,975 t of seer fishes was landed which contributed 2.8% to the total marine landings. Trawl, gill nets, purse seine and *dol* nets contributed 14%, 81%, 3% and 2% respectively. Spawning stock biomass was 3,384 t and formed 56% of the standing stock biomass.
- ***Mackerel*:** 7,152 t of mackerel was landed which contributed only 2% to the total marine landings of the state. The landings showed a decline by 25% when compared to last year.

- **Elasmobranchs**: An estimated 10,229 t was landed which formed only 2.8% of the total marine landings. Trawls, gill nets and *dol* net contributed 40%, 57% and 2.5% respectively. The catch consisted of 14 species of sharks, 11 species of rays and 4 species of skates.
- **Lizard fishes:** The estimated landings of lizardfish was 2,023 t; the landings were entirely from the trawlers and the catch rate was 0.32 kg/hr. Landings recorded a 41% increase compared to 2007.
- **Pomfrets**: Landings of pomfrets declined by 8% from 6551 t in 2007 to 6059 t in 2008. Major gear for silver pomfret *Pampus argenteus* was *dol* net (92%) followed trawl (58%) and gill nets (25%).
- **Polynemids:** The estimated landings in 2008 was 981 t as against 1434 t in 2007 which was a 32% decline. *Polynemus heptadactylus* (85%), *P. indicus* (13.5%) and *E. tetradactylus* (1.3%) were the major species.
- **Sciaenids:** Croakers contributed 8.4% to the total fish landings in the state. Though landings decreased by only 1%, a 20.4% increase was recorded in trawl. CPUH for trawlers was 5.84 kg/hr at NFW and 3.40 at Versova. The species composition in trawl showed dominance of minor sciaenids *J. macrorhynus* (29.8%), *O. cuvieri* (22.8%) and *J. vogleri* (22%).
- **Groupers:** An estimated 2,272 t of groupers was landed in Maharashtra which contributed 0.6% to the total marine fish. Compared to 2007, the catch recorded a decline of 47%.
- **Catfishes:** Catfishes contributed 3.2% to the total marine landings. Trawlers (44%) and gill netters (39%) were the major gears for exploitation of the resource. Among the catfishes, *O. militaris* dominated (27%) followed by *A. dussumieri* (26%), *A. tenuispinis* (25%), *A. caelatus* (13%) and *A. thalassinus* (2%).
- **Threadfin breams:** Threadfin breams contributed 4.6% to the total marine landings which showed an increase 35% when compared to 2007. *N. japonicus* (59%) dominated the catch of threadfin breams followed by *N. mesoprion* (40%) and *N. delogae* (1%).
- **Penaeid shrimps:** Estimated landing of penaeid prawns was 46,828 t of which 79% was contributed by the trawlers and 18% by the *dol* nets. The catch recorded 4.6% decline over last year. *P. stylifera* was the dominant species contributing 25.1% followed by *S. crassicornis* (24.1%), *M. affinis* (23.9%) and *M. monoceros* (12.5%) which together formed 86% of the total penaeid shrimps. Compared to 2007, landings of *P. hardwickii* (+184%) and *S. crassicornis* (+77%) increased while the rest showed decline.
- **Non-penaeid shrimps:** An estimated 70,965 t of non-penaeid shrimps was landed which contributed 19.8% to the total fish landings. *Dol* net contributed bulk of the catch (85%).
- **Lobsters:** Estimated landings of lobsters was 403 t of which 201 t (50%) was contributed by trawlers, 43% by gill nets and 7% by other gears recording a 40% decline compared to 2007. During the year, 4.3 t of sand lobster *Thenus orientalis* was landed by trawlers in addition to *P. polyphagus* (118 t) at NFW in Mumbai. In trawlers,

Landing of eels at Mumbai

Koth landings at Mumbai

Catfish juveniles

Solenocera crassicornis landing at Mumbai

67% of the catch of *P. polyphagus* consisted of juveniles below the size at maturity.

- **Crabs**: 1,279 t of crabs was landed during the year; the dominant species was *C. feriatus* (54.8%), *P. sanguinolentus* (30.8%), *P. pelagicus* (4.2%) and other crabs (10.2%).
- **Cephalopods**: An estimated 18,073 t was landed by the trawlers (99%). At NFW, the catch was constituted by squids *Loligo duvauceli* (54%) followed by *S. pharaonis* (10.9%), *S. aculeta* (13.1%), *S. inermis* (19%) and *Cistopus indicus* (3%).

PROJECT CODE	**CF/IDP/02**
PROJECT TITLE	**Resource damage assessment in marine fisheries: impact of selective fishing of juveniles and bycatch and discards in trawl fisheries**
SCIENTISTS	**E.V.Radhakrishnan,** R. Sathiadas, J.Jayasankar, Rekhadevi Chakraborty, S.Lakshmi Pillai, Subhadeep Ghosh, M. Zaffar Khan, Paramita Banerjee Sawant, A.P.Dineshbabu, Sujitha Thomas, K.K. Philippose, P.P.Manojkumar, M.Rajamani, Shoba Joe Kizhakudan and G. Maheswarudu
CENTRES	Cochin, Veraval, Mumbai, Mangalore, Calicut, Mandapam, Tuticorin, Chennai and Visakhapatnam

- The Low Value Bycatch (LVB) landed and discarded by trawlers was monitored at fish landing centres at Veraval, Mumbai, Mangalore, Calicut, Cochin, Tuticorin, Mandapam, Chennai and Visakhapatnam. Quantificatiaon of fishes and shrimps landed by *dol* nets at Mumbai, minitrawls at Cochin, *thallumadi* at Tuticorin and *thalluvalai* at Mandapam was also carried out.
- During January-December 2008, an estimated 35935 t of LVB with a catch rate of 23.7 kg/hr was landed by trawlers (locally known as *kutta*) at Veraval, which formed about 25.4% of total trawl catch. The estimated discards by trawlers were 2801 t at a catch rate of 1.9 kg/hr. An estimated 259 t of LVB with a catch rate of 6.2 kg/hr, (27% of trawl catch) was landed by trawlers at Versova. Nearly 90% of flat fishes in LVB was constituted by juveniles. In crustaceans, 37-98% were juveniles. Fishermen reported that the entire LVB brought to the shore was sold to fishmeal plants.

Low value bycatch from SDF trawl

- At Mangalore, an estimated 22696 t of LVB was discarded by Multiday Fishing trawlers (MDF). Single Day trawlers (SDF) landed 467t of bycatch, which formed 24% of total catch. Finfishes (101 species), crustaceans (39 species) and molluscs (52 species) were the major components.
- At Calicut, an estimated 17289 t (47.1%) of LVB was landed by trawlers with an average catch rate of 19.7 kg/hr. Discards formed 17% (6264 t) of the total trawl landings. Finfishes (69.1%), crustaceans (8.2%) and molluscs (12.5%) were the main components of the bycatch. 134 species of finfishes, shellfishes and other organisms were observed in the LVB.
- An estimated 1957 t of LVB was landed by SDF trawlers at Quilon.

Finfishes (34%), crustacean (30%) and molluscs (28%) were the major constituents.

- At Chennai, LVB from trawl constituted 3277 t (inclusive of the discards), which formed 14% of total trawl landings. Discards alone formed 7.8% of total LVB. Fishes formed 61% of LVB and the remaining was by crustaceans (32%) and molluscs (10%).

- At Visakhapatnam an estimated 704.5 t of LVB was landed with a catch rate of 0.4 kg/hr, whereas 1684 t of LVB were discarded accounting for 32.3 % of total trawl catch. LVB was constituted by finfishes (70.6%), crustaceans (26.2%) and molluscs (3.2%).

Juvenile pomfret landings at Vasai

Selective Fishing gears

- *Dol* nets in Sassoon docks, Mumbai landed 147 t of fishes with a catch rate of 1.7 kg/hr. Non-penaeid shrimps (24%), penaeid shrimps and Bombayduck (19% each) were the main components. Species diversity showed 83 different species of marine organisms in *dolnets*. 17 species of finfishes and shellfishes represented in the '*dolnet*' were juveniles.

- At Arnala, *dol* nets landed 2869 t of fishes with a catch rate of 17 kg/hr. *Harpadon nehereus* (30%) dominated the catch followed by engraulids (26%) and non-penaeid shrimps (20%). 74 species of marine organisms were represented and of these 44 species were finfishes. 24 species of finfishes and shellfishes landed were below size at first maturity and therefore juveniles.

- Minitrawls at Pallithode along the Alleppey/Ernakulam coast landed 111 t of fishes and shellfishes of which shrimps formed 89.6%. *Metapenaeus dobsoni* (49.2 %) and *Parapenaeopsis stylifera* (46.5%) are the two major species. Percentage of juveniles in minitrawl landings were 57.5% and 47% for *M. dobsoni* and *P. stylifera*, respectively. Destruction of juveniles by minitrawls was about four times more than the commercial trawlers.

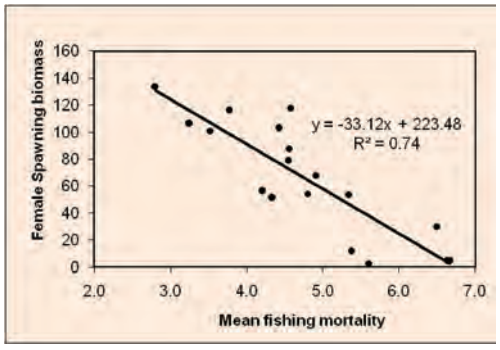
- *Thallumady* operation at Mottagopuram, Tuticorin coast landed 74.8 t of shrimps with a CPUE of 75.5 kg of which juvenile shrimps formed 22.4 t (30%). An estimated 31.9 t of shrimps were landed at Alangarathattu of which 10% were juveniles. *P. semisulcatus* with length range 50-93 mm was the dominant species.

- At Mandapam, an estimated 42.9 t of *P. semisulcatus* with a catch rate of 4.7 kg/unit were landed by *thalluvalai* at Tiruppulaikudi, Ramanathapuram district, Tamilnadu. At Devipatnam, an estimated 36.3 t was landed with a catch rate of 6.6 kg/unit. The size of *P. semisulcatus* landed at Tiruppalaikudi and Devipatnam, ranged from 56-186 mm and 83-181 mm total length respectively.

- At Thiruppalaikudi and Devipatnam 74.6 % and 80.4% of shrimps landed were juveniles. In October 2008, 2.1 million (49.5%) juvenile female shrimps were landed at Tiruppulaikudi. This points at the destruction caused to the resource by the gear since the shrimps are caught even before first spawning.

Bycatch landed by trawlers

PROJECT CODE	**CF/RE/03**
PROJECT TITLE	**Recruitment dynamics of penaeid shrimps along the Indian coast**
SCIENTISTS	**V. D. Deshmukh,** A.P. Dineshbabu, P.T. Sarada, M. Rajamani, G. Maheswaradu and Lakshmi Pillai
CENTRES	Mumbai, Mangalore, Calicut, Mandapam, Visakhapatanam and Kochi



P. stylifera SSB against mean F

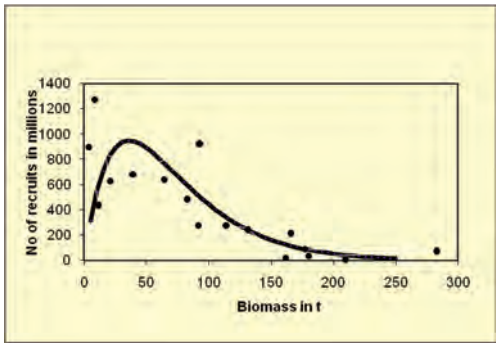
- The project was approved in August 2008 and the actual work commenced from September 2008. During the period, past 10 years of fishery and biological data on penaeid shrimps have been compiled and re-organized on calendar year basis from important observation centres at Mumbai (NFW and Versova), Mangalore (FH), Calicut (Puthiappa), Mandapam and Visakhapatanam.
- Despite the increasing fishing effort at all the centres the time series of shrimps landings during 1997-2006 indicated declining trend at Mumbai and Mangalore and an increasing trend at Chennai and Visakhapatanam.
- Analysis of monthly length frequency distribution of important species was used for the estimation of von Bertalanffy growth parameters by ELEFAN and other methods.

Requirement for SRR:

Month-wise spawning stock biomass of female shrimps shows decline due to increasing fishing mortality.

Parapeneopsis stylifera:

- Month-wise spawning stock biomass and recruitment number for 5 months were obtained by LCOHOR programme.
- Tested by 2 models: Beverton & Holt & Ricker's models.
- Ricker's model gave the best fit (r^2=0.84).
- Suggests stock dependent control mechanism on the recruitment.
- Correlation of monthly estimated number of recruits and the spawning stock biomass of *P. stylifera* (Mumbai) was attempted. The spawning stock biomass and the number of recruits arriving in the fishing grounds five months later were regressed. The regression of recruits (in millions) and the spawning stock biomass by Ricker's model gave the best results. The 17 data points observed during 2002 and 2003 revealed that as the stock increased the recruitment (after 5 months) also increased, but with further increase in stock the recruitment declined exhibiting a dome shaped Ricker's relationship.



P. stylifera SRR curve

- According to the model, recruitment increased initially, but decreased at high stock levels, which explains the stock dependent control mechanism on the recruitment.
- Similar attempt was made for *M. monoceros* in Visakhapatanam waters which also showed better fit by Ricker's model.

PROJECT CODE	**DEM/IDP/01**
PROJECT TITLE	**Management advisories for sustaining marine fisheries of Tamil Nadu and Puducherry**
SCIENTISTS	**P.U. Zacharia,** V. Kripa, K.K. Joshi, A. Raju, M. Rajamani, V. Venkatesan, G.Mohanraj, H. Mohamed Kasim, Shoba Joe Kizhakudan, Sathianarayana Sethi, T.V. Sathianandan and K.N. Saleela
CENTRES	Tuticorin, Mandapam Chennai and Vizhinjam

- The estimated marine fish landings along Tamil Nadu and Puducherry coast were 4,26,036 tonnes (4,12,066 t in 2007) and 14,943 tonnes (14,721 t in 2007), respectively during 2008. It was estimated that 55% of the catch was contributed by mechanized trawlers, 38% by gillnetters, hooks & line 3.9% and seines 2.4%. The most productive period was the 3rd quarter (July-September) and the second quarter recorded the lowest catch (20.7%).
- Pelagics contributed 47%, demersals 33%, crustaceans 8% and molluscs 5% to the total landings. A noteworthy feature during this year was an increase of 14,357 t of demersal landings (11.8%), whereas the landing of pelagics decreased by 27,158 t (12.2 %) as compared to the previous year. The landing of molluscs significantly increased by 91%.

Fishermen mending their nets at Manapad landing centre

Pelagic fish resources

- The total sardine landings was 1,03,996 t; oil sardines contributed 62,488 t. Landings of siverbellies decreased by 10% compared to the previous year.
- The other major groups were lesser sardines, perches and carangids. At Chennai, growth parameters were estimated and VPA carried out for *S. gibbosa* and *S. longiceps*. For *S. longiceps*, L_{∞} was estimated as 195 mm and K at 1.55; Z varied from 2.55 at 135 mm to 5.1 at 195 mm. The spawning stock biomass (SpSB) formed 37.9% of the standing stock biomass (StSB), which shows a good number of spawners in the population.
- Landings of the Indian mackerel *Rastrelliger kanagurta* (11,998 t) declined by about 25% from that of previous year. Length of *R. kanagurta* in trawl ranged from 131 to 270 mm with mean length of 209 mm at Chennai and 196.4 mm at Cuddalore. The growth parameters were: L_{∞} = 270 mm and K=1.3. SpSB was very high and contributed 88.9% to the StSB.
- Ribbonfish landings was constituted by a single species (*Trichiurus lepturus*) at Chennai, Puducherry, Cuddalore and Tuticorin. The length range of *T. lepturus* in trawl landings was 251-1200 mm with mean length of 514 mm. Immature female fishes were dominant at Cuddalore. Growth parameters were estimated as L_{∞} =1200 mm, K=1.5yr^{-1}. The SpSB was very high, and contributed 77.5% to the StSB.
- The total production of tunas was 15,316 t, landed mainly by DGN and H & L. Four species was landed at Chennai and six at Tuticorin. Yellowfin tuna *Thunnus albacares* (31.3%) was dominant in the catches followed by *Katsuwonus pelamis* (30%), *Auxis thazard* (24%) and *Euthynnus affinis* (14.7%) at Chennai. The size of *T. albacares* ranged from 32 to 88 cm.

Snake mackerel landed by trawelrs at TFH

Pig-face breams landed by hook& line at Therspauram landing centre near Tuticorin

Demersal fish resources

- An estimated 9,721 t of elasmobranchs was landed. Rays dominated the landings at Chennai (66.2%), Mandapam (96%) and Tuticorin (86%). Ten species each of sharks and rays were found in the landings at Chennai. *Dasyatis jenkinsi* and *Himantura uarnak* were dominant at Chennai, while *H. uarnak* and *H. bleekeri* dominated at Tuticorin and Mandapam respectively. *Carcharhinus sorrah, Scoliodon laticaudus, C. leucas* and *Sphyrna lewini* dominated the shark landings at Chennai. At Tuticorin, *S.laticaudus* was the dominant species among sharks; six species of rays were landed of which *H.uarnak* was the most dominant. In Palk Bay, 12 species of rays were landed. In Gulf of Mannar, 11 species were recorded of which *A. narinari* dominated followed by *H. bleekeri*.
- Stock estimates of goatfish *Upeneus sundaicus* indicate that the stock is exploited over optimum level (E=0.76) in Palk Bay and Gulf of Mannar.
- As in the previous year, greater degree of species diversity was observed in lizardfish landings with species like *Saurida undosquamis, S. tumbil, S. micropectoralis, S. longimanus* and *Trachinocephalus myops* occurring in the landings at Chennai.
- The growth and mortality parameters were estimated for *Leiognathus splendens* and the SpSB was 88% of the StSB off north Tamil Nadu. VPA on *L. jonesi* at Mandapam indicates that the stock is subjected to heavy fishing pressure (E = 0.82).

Crustacean resources

Deep sea shrimps landed in trawl net

- Penaeid shrimps landings along Tamil Nadu and Puducherry coast was 20,566 t. At Mandapam, *Penaeus semiculcatus* was dominant throughout the year forming 52.8% of the landings followed by *M. stridulans*. The size of *P. semisulcatus* in the fishery ranged from 101-180 mm for males and 101-210 mm for females. The SSB constituted 81% of the StSB.
- The lobster catch was 432 t during 2008 as against 226 t during 2007. While the crab landing was 13,273 t. In shallow waters, *Portunus pelagicus* showed dominance, whereas in deeper waters *P. sanguinolentus* dominated.

Molluscan resources

- Cephalopod landings increased from 10,304 t (2007) to 18,592 t (2008). Squids contributed 52.8%, cuttlefish 42.1% and octopus 5.1%. At Chennai, out of 11 species of cephalopods, *Sepia pharaonis* formed 22.1% and *S. aculeata* 13.1%. At Tuticorin, squids formed 85% of trawl catch, while cuttlefish formed 68% in H & L. *Sepia ramani* formed 49.1% of the H&L landings at Kalavasal and among squids, *Sepioteuthis lessoniana* was dominant.
- An estimated 791 t of gastropod was landed. At Chennai, 21 species were recorded *Hemifusus fugilinus* was the dominant species (28.4%). At Mandapam, *Xancus pyrum* var. *acuta* and *X. pyrum* var. *obtusa* occurred in the fishery. The length ranged from 50-120 mm with mode at 80 mm. At Tuticorin, the fishery of *Xancus*, *Chicoris* and *Lambis* was monitored.

Estimated Potential Yield

- Estimation of potential yield and maximum sustainable fleet size for the fisheries in Tamil Nadu was carried out using data on species / groupwise and gearwise marine fish landings and effort (both in units and hours of operation) during 1997-2007. Potential yield estimates were calculated based on a simple high pass filter (five point moving average) of the individual species landings and considering the maximum landings of the filtered data. The estimate of total potential yield for Tamil Nadu is 4,35,479 t and the average observed figure for the landings during 1997-2007 is 3,96,880 t. The total of observed maximums of all the species during this period was 5,95,577 t.

Bycatch landed by trawl being taken for making fish manure and poultry feed.

Gearwise effort and catch of marine fish landings in Tamil Nadu

Gear	Trawl	Gillnet	Hook & Line	Seines	Artisanal
Total catch (kg)	242538	168454	17198	10583	1764
Effort (Units)	365395	2032147	235206	23046	28275
Effort (AFH)	55,76133	121.70426	14,44073	1,91987	169551
% to total catch	55.0	38.2	3.9	2.4	0.4

Ten major resources and their percentage in different gears and peak period of production at Tamil Nadu

Resource	Catch (t)	Trawl	Gillnet	H&L	Seines	Artisanal	Peak period
Oil sardine	62,488	10.9	81.0	0.0	7.84	0.09	Jul-Sep
Silverbellies	43,989	89.6	9.5	0.4	0.18	0.24	Jan-Mar Jul-Sep
Lesser sardines	36,025	24.9	67.0	1.26	5.12	0.78	Jan-Mar
Perches	34,212	69.3	14.0	16.4	0.32	0.08	Jul-Sep
Carangids	25,299	58.7	39.0	0.97	1.01	0.23	Jan-Mar
Other clupeids	18,919	39.5	59.6	0.01	0.27	0.22	Apr-Jun
Prawns	18,215	88.1	11.1	0.03	0.16	0.00	Jul-Sep
Cephalopods	18,096	89.0	5.5	5.43	0.00	0.02	Jul-Sep
Tunas	11,992	7.0	48.0	33.5	11.55	0.03	Apr-Jun
Crabs	11,467	48.3	50.2	0.01	1.32	0.03	Jul-Sep
Pig-face breams	10,601	45.8	19.6	34.3	0.23	0.00	Jan-Mar
Indian mackerel	9,734	10.3	86.3	0.08	3.07	0.26	Jul-Dec

Major resources and their status of exploitation at different centres

Resource	Gear	Centre	Exploitation level
Threadfin breams	Trawl	Chennai	Below optimum
Silverbellies	Trawl	Chennai	Below optimum
Goatfishes	Trawl	Mandapam	Optimum
Sciaenids	Trawl	Chennai	Optimum
Penaeid shrimps	Trawl	Mandapam	Optimum
Crabs	Trawl	Mandpam	Optimum
Oil sardine	Gillnet	Tuticorin	Optimum
Carangids	Hook & line	Tuticorin	Optimum
Threadfin breams	Trawl	Tuticorin	Optimum
Penaeid shrimps	Trawl	Chennai	Above optimum
Crabs	Trawl	Chennai	Above optimum
Silverbellies	Trawl	Mandapam	Above optimum
Goatfishes	Trawl	Mandapam	Above optimum
Sacred chank	Trawl	Mandapam	Above optimum
Silverbellies	Trawl	Tuticorin	Above optimum

Estimates of potential yield (t) with the data for 1987-2007

Species	Potential yield	Maximum yield	Average yield
Sharks	5579	10530	4693
Rays	11781	15444	10504
Lizardfishes	4518	5653	3723
Perches	22523	27133	20664
Goatfishes	6851	10125	6366
Croakers	10367	11645	9063
Silverbellies	38666	48825	38002
Penaeid prawns	23456	28348	19770
Lobsters	380	998	300
Crabs	13429	15455	12589
Cephalopods	11455	15464	10853
Total Demersals	**177663**	**230911**	**161615**
Seerfishes	9211	14377	7886
Tunas	8989	16268	7161
Billfishes	832	1455	731
Barracudas	6802	8669	6347
Large pelagics total	25839	40798	22143
Oil sardine	58662	77715	49404
Other sardines	45671	61989	44283
Anchovies	11	49	27
Stolephorus spp.	12503	15636	10099
Other clupeids	19951	24165	17998
Ribbonfishes	4514	5311	3598
Carangids	24740	30045	23158
Indian mackerel	18067	22974	16404
Small pelagics total	198794	259568	176205
Total catch	**435479**	**595577**	**396880**

PROJECT CODE DEM/IDP/02

PROJECT TITLE **Development of management advisories for sustaining marine fisheries of Gujarat**

SCIENTISTS **Subhadeep Ghosh,** Gulshad Mohammed and R. Thangavelu

CENTRE Veraval

Processing of jellyfish at Jakhau

- The estimated annual landings in Gujarat was 5,44,332 tonnes during 2008, which was 15% higher than that of 2007.
- The maximum landings was that of non-penaeid shrimps (80,415 t; 14.7%) followed by sciaenids (55,514 t; 10.2%), Bombayduck (43,987 t; 8.1%) and ribbonfishes (41,965 t; 7.7%).
- Gujarat contributed 17.3% to the all-India marine fish landings. The groups/species which contributed significantly (> 30%) to the respective all-India landings: *Thunnus tonggol* (83.9%), crabs (46.7%), Bombayduck (43.9%), non-penaeid prawns (43.0%), catfishes (37.7%), threadfins (37.1%), cuttlefishes (33.5%), sciaenids (31.9%) and skipjack tuna (31.6%).
- Expending an effort of 1.5 million fishing hours, trawlers landed 1,41,161 t at Veraval with a catch rate of 94.1 kg/h.
- The estimated catch of Bombayduck by *dolnets* from the inshore grounds of Nawabunder, Rajpara and Jaffrabad was 27,216 t (25.1%

of the dolnet catches) for an effort of 67,216 units with catch rate of 404.9 kg/unit.

Biological characteristics and stock assessment

- Biological characteristics and stock assessment was studied for 12 species of pelagic finfish. Fecundity of *Rastrelliger kanagurta* (374 eggs per g body weight), *Coilia dussumieri* (381 eggs per g body weight) and *Alepes kleinii* (458 eggs per g body weight) was very high. *Harpadon nehereus, Coilia dussumieri, Thunnus tonggol, Euthynnus affinis* and *Sarda orientalis* had bimodal recruitment. The exploitation rate of *H. nehereus, S. guttatus, Megalaspis cordyla, Ilisha megaloptera, Thunnus tonggol*, *Euthynnus affinis* and *Auxis thazard* was high (0.53 - 0.81). It was found that the yield of these stocks were higher than MSY indicating the need for reducing the effort off Veraval. Diet composition of all the 12 species was studied. All species except *S. guttatus, T. tonggol* and *S. orientalis* had *Acetes* as an important component in the diet. For *S. guttatus, T. tonggol* and *S. orientalis,* the diet consisted of finfish and cephalopods.
- Biological characteristics and stock assessment were studied for 7 species of demersal finfish landed at Veraval. Females of *Priacanthus hamrur* and *Saurida undosquamis* were dominant in the landings. Fecundity of all species was high - *P. hamrur* (553 eggs per g body weight) and *S. tumbil* (513 eggs per g body weight). Except for *S. undosquamis* (bimodal recruitment) all other species showed unimodal recruitment. The length-at-first capture was very small (6.7 cm) for *Nemipterus japonicus*. The exploitation rate (E) was high for *P. hamrur* (0.57), *Johnius glaucus* (0.56) and *N. mesoprion* (0.51). It was found that the yield of these stocks were higher than the MSY indicating the need for reducing the effort off Veraval. All 7 demersal species had *Acetes* as an important component in the diet. In addition, all had predated on other finfishes.

Huge landing of *ghol* at Okha in October

Biological characteristics of pelagic resources landed at Veraval

Species	L_c (cm)	Mean Length (cm)	L_{inf} (cm)	k	M	F	Z	E	Recruitment	Q/B
Harpadon nehereus	7.13	21.3	37.01	0.45	0.98	1.22	2.2	0.55	Feb-March & June-Oct, bimodal	10.6
Coilia dussumieri	11.29	15.3	21.53	0.76	1.61	1.05	2.66	0.39	March –April & Aug-Nov, bimodal	13.8
Scomberomorus guttatus	31.83	44.51	64.05	0.60	1.02	1.21	2.23	0.54	Unimodal, Feb-July	13.7
Alepes kleinii	14.72	17.84	27.83	0.28	0.78	0.2	0.98	0.20	Unimodal, Feb-August	18.4
Megalaspis cordyla	23.92	35.15	49.88	0.43	0.88	1.21	2.09	0.58	Unimodal, Feb-Aug	19.8
Ilisha megaloptera	25.64	31.29	43.05	0.42	0.9	1.01	1.91	0.53	Unimodal, Feb-Aug	
Rastrelliger kanagurta	19.74	23.42	28.88	0.66	1.35	1.09	2.44	0.45	Unimodal, Feb-Aug	
Thunnus tonggol	60.80	64.62	97.65	0.27	0.54	2.34	2.88	0.81	Bimodal, May-August & Oct-Nov	15.9
Euthynnus affinis	36.57	50.26	72.45	0.34	0.68	0.77	1.45	0.53	Bimodal, April-July & Sept-Nov	11.6
Auxis thazard	30.47	38.30	51.45	0.49	0.95	1.37	2.32	0.59	Unimodal, March-Sept.	18.2
Sarda orientalis	41.50	45.48	61.95	0.36	0.74	0.24	0.97	0.24	Bimodal, May-June & August-Oct	
Katsuwonus pelamis	42.30	59.26	80.85	0.45	0.79	0.21	1	0.21	Unimodal, March-Sept.	

Results of stock assessment studies of pelagic resources landed at Veraval

Species	Annual Yield (t)	Annual Stock (t)	Standing Biomass (t)	MSY (t)
Harpadon nehereus	27215	55193	22308	24538
Coilia dussumieri	4615	12571	4395	5846
Scomberomorus guttatus	285	589	236	263
Alepes kleinii	79	619	395	193
Megalaspis cordyla	163	322	135	141
Ilisha megaloptera	110	244	109	104
Rastrelliger kanagurta	143	352	132	161
Thunnus tonggol	1372	1789	586	844
Euthynnus affinis	580	1426	753	546
Auxis thazard	187	352	136	158
Sarda orientalis	0.5	3.6	2.3	1.1
Katsuwonus pelamis	1604	12089	7642	3821

Growth parameters of demersal resources landed at Veraval

Species	L_c (cm)	L_{inf} (cm)	k	M	F	Z	E	Recruitment
Nemipterus mesoprion	8.70	24.1 5	0.43	1.07	1.12	2.19	0.51	Unimodal, Jan-July
Nemipterus japonicus	6.67	30.45	0.44	1.02	0.37	1.39	0.26	Unimodal, May-Sept
Saurida tumbil		49.35	0.16	0.46				Unimodal, July-Oct
Saurida undosquamis		40.95	0.19	0.54				Bimodal, April-May & July-Sept
Priacanthus hamrur	11.68	33.60	0.33	0.82	1.08	1.90	0.57	Unimodal, Feb-August
Otolithes cuvieri	11.18	37.80	0.32	0.78	0.47	1.25	0.38	Unimodal, April-Oct
Johnius glaucus	9.98	31.50	0.55	1.17	1.48	2.65	0.56	Unimodal, May-Sept
Cynoglossus arel		50.40	0.19	0.52				Unimodal, March-July

Results of stock assessment studies of demersal resources landed at Veraval

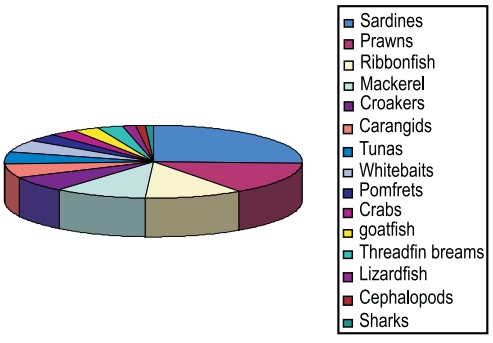
Species	Annual Yield (t)	Annual Stock (t)	Standing Biomass (t)	MSY (t)
Nemipterus mesoprion	4519	9949	4034	4418
Nemipterus japonicus	7503	37536	20278	14093
Priacanthus hamrur	15870	32829	14694	13959
Otolithes cuvieri	3819	14235	8125	5078
Johnius glaucus	3885	7485	2625	347

PROJECT CODE MF/CAP/01

PROJECT TITLE **Developing management advisories for sustaining marine fisheries of Andhra Pradesh**

SCIENTISTS **Prathiba Rohit,** M. Srinath, G. Maheswarudu, S. Immanuel, U. Rajkumar (all CMFRI), R. Reghu, Rajeswari (both CIFT)

CENTRE Visakhapatnam



Major groups supporting the fishery

- An estimated 2,08,099 t of marine fish was landed at Andhra Pradesh which showed a 1.3% decrease than the previous year. Pelagic resources was the dominant group (57.6%) and showed 2.9% growth over the previous year. Major share was from the mechanised sector (55.9%).
- Among the fish landed, the dominant species were sardines, *Sardinella gibbosa* (35.7%), mackerel *Rastrelliger kanagurta* (95.6%), tunas *Thunnus albacares* (79.7%), threadfin breams *Nemipterus japonicus* (62.8%), elasmobranchs, rays (70.5%), lizard fish *Saurida undosquamis* (40.4%), goat fishes *Upeneus sulphurus* (26.1%) and sciaenids *Otolithes ruber* (25.8%).
- Among pelagic resources, sardine landings increased by 122.5%, mackerel by 150.9%, ribbonfish by 54.5%, tunas 42.6%; seer fish showed a sharp decline of 70% in landings.

- Among crustaceans, prawn landings showed a decline of 6.4%, but crabs showed an increase of 72.7%. Cephalopods also showed a 39% decline in landings.

Comparative assessment of catch and effort with that of previous year

- The total marine fish landings of Andhra Pradesh decreased by 1.3 %.
- Landing of pelagic fishes increased by 2.9%. Demersal, crustacean and molluscan resources declined by1.3%, 6.8% and 39.3 % respectively.
- The catch by mechanized sector and non-mechanized sector declined by 25% and 37% respectively, whereas the catch by the motorized sector increased several folds. Effort expended by trawls (8.9%) and all gears operated by the motorized crafts registered an increase. Effort by the mechanized GN, H & L and the non mechanized gears declined.
- Total fish catch by all gears except trawl declined. Ttrawls registered an increase of 12%. The decrease in catch by the seines, gillnet and H & L were 19%, 35% and 72% respectively.
- Among the major pelagics, total sardine catch increased by 122.5%, mackerel by 150.9%, ribbonfish by 54.5%, and tunas by 42.6%. Seerfish catch declined by 70 %.
- Landing of lizardfish and goatfish registered an increase of 34% and 16.4% respectively. Threadfin breams declined by 17.6%, pomfrets by 43.7%, elasmobranchs by 41.2% and croakers marginally by 0.6%. Landing of penaeid prawns declined by 6.4% whereas. Crab landings increased by 72.7%. The cephalopod catch declined by 39%.

Growth and mortality parameters of important species in Andhra Pradesh

Species	L_∞ (cm)	K /yr	Z	M	F	E
S. gibbosa	19.13	1.8	9.87	2.9	6.97	0.7
R. kanagurta	27.9	1.7	13.8	1.38	11.7	0.9
T. lepturus	103.8	0.26	1.93	0.51	1.42	0.73
S. guttatus	64.22	1.31	2.65	1.68	0.97	0.36
T. albacares	240	0.2				
N. japonicus	32.25	0.60	3.31	1.22	2.08	0.63
S. undosquamis	39.8	0.33	1.76	0.777	0.96	0.55
U. vittatus	20.8	0.52	2.05	1.257	0.79	0.38
J. carutta	29.7	0.32	2.09	0.44	1.65	0.79
O. ruber	46.13	0.45	1.89	0.916	0.97	0.515
S. pharaonis	32.7	0.82	3.35	1.49	1.85	0.55
L. duvauceli	23.9	1.35	12.9	2.25	10.65	0.83
M. monoceros						
male	18.5	2.2	8.79	1.84	6.95	0.79
female	22.4	1.78	8.03	1.51	6.52	0.81
M. dobsoni						
male	11.9	1.4	6.78	1.54	5.24	0.77
female	12.5	1.75	11.14	1.78	9.38	0.84
P. sanguinolentus						
male	23	1.4	9.97	2.44	7.53	0.76
female	22	1.3	11.69	2.35	9.34	0.8

Stock assessment studies of commercially important species contributing to the fishery of Andhra Pradesh has revealed that most of these resources are being exploited at levels higher than that desired and adoption of management measures are to be taken up seriously and systematically to bring back the fishery to healthier long term sustainable levels.

Stock estimates of important commercial species in Andhra Pradesh

Species	Gear	Spawning Stock (t)	Standing Stock (t)	Yield(t)
S. gibbosa	combined	150	584	40431
R. kanagurta	combined	6197.01	23288.72	3762
T. lepturus	combined	95851	119051	29506
S. guttatus	combined	956	1260	3315
N. japonicus	Trawl	3854.21	5298.58	5628
S. undosquamis	Trawl	907.4	6153.2	3031
O. ruber	Trawl			
U. vittatus	Trawl	7409.5	20348	6673
M. monoceros				
males	Trawl	169.6	177.4	248
females	Trawl	418.84	453.89	732
M. dobsoni				
males	Trawl	104	104	204
females	Trawl	167	226.1	317
P. sanguinolentus				
males	Trawl	73.6	73.6	255
females	Trawl	96.2	96.2	375

FUNDING AGENCY **Marine Products Export Development Authority**
PROJECT TITLE **Participatory management and conservation of lobster resources along the Indian coast**
SCIENTISTS **E.V. Radhakrishnan** (CMFRI), B. Meenakumari and Pravin Puthran (CIFT)
CENTRE Cochin

Lobster landings

- Several communication tools were released to create awareness among the fishermen on the negative impact of fishing juveniles and egg bearing lobsters.
- A video film on lobster conservation in five languages has been produced.
- 30 lobster traps (new design) were distributed free to fishermen at Enayam fishing village.

FUNDING AGENCY **Marine Products Export Development Authority**
PROJECT TITLE **Demonstration of responsible fishing practices for the trawl fisheries of Gujarat State**
SCIENTISTS **K. S. Mohamed,** P.K. Asokan, S. Ghosh, E. Vivekanandan (all CMFRI); B. Meenakumari, P. Pravin, V.R. Madhu (all CIFT)
CENTRES Kochi and Veraval

- The objectives of the project were to operate 3 commercial trawl vessels from Veraval Fishing Harbour for one fishing season with the MFRA notified mesh sizes and in-tune with FAO Code of Conduct for Responsible Fisheries and to demonstrate the economic viability of such trawl operations as compared to the existing trawling practice using small meshes.

The initial assessment of results indicated the following:

- The initial comparisons of catches between the experimental (using notified mesh sizes) and the control trawlers (20 mm diamond shaped meshes in codend), showed no significant escapement of commercially important species from the 40 mm mesh size codend.
- The escaped species were dominated by jellyfishes, juveniles of ribbonfish, mackerel and Bombay duck.
- The average proportion that had escaped from the 40 mm mesh codend worked out to be 3.35 % in terms of weight of the total catch. This proportion usually forms the incidental catches that are used for the drying, and hence the value per kilogram is only INR 2-3.

MFB Yash Sagar of M/s KR Seafoods, Porbandar which is conducting responsible trawling in the 2008-09 season

FUNDING AGENCY	**Ministry of Earth Sciences**
PROJECT TITLE	**Assessment of fishery resources in the continental slope of Indian EEZ and Central Indian Ocean**
SCIENTISTS	**U. Ganga,** E.M. Abdussamad, Prathibha Rohit and Shubhadeep Ghosh
CENTRES	Cochin, Visakhapatnam and Veraval

- Exploratory surveys of the deep-sea demersal fin fishes off the west coast in 8 – 20° N latitude indicated that the maximum number of families (29) occurred in the depth range 600 - 800 m followed by 400 m (21) and 400-600 m depths (20). Families which showed the highest abundance in terms of catch were Chloropthalmidae, Ophiididae, Muraenidae, Stromateidae and Macrouridae. The most abundant species were *Chloropthalmus bicornis*, *C. punctatus, Uranoscopus archionema, Eridacnis radcliffei, Lampogrammus exutus, Gavialiceps taeniola* and *Bembrops caudimaculata*.
- Off the east coast, while 22 families were represented in the catches at 200-400 m depths, 28 families were observed at 400-600 m depths. Compared to this, only nine families were recorded in 600-800 m depth and six families in the depth beyond 1000m. The most common family in the 200-400 m depth was Priacanthidae represented by *Priacanthus hamrur.* Rhinochimaeridae in the 400-600 m depth was represented by the species *Neoharriotta pinnata*. The eel *Bathyuroconger brauei* (Congridae) was recorded in the 600-800 m depth.
- Targeted fishery for deep-sea sharks by select DGN cum H & L units operating at depths beyond 400 m has developed lately at Cochin Fisheries Harbour. Deep-sea chondrichthyan landings comprised of more than 14 species of sharks belonging to the family Hexanchidae, Echinorhinidae, Centrophoridae, Squalidae, Carcharhinidae, Triakidae, Scyliorhinidae, Somniosidae, Alopiidae and Rajidae and chimaeras belonging to family Rhinochimaeridae.
- Maximum diversity was observed in Squaliformes with species such as *Centrophorus squamosus*, *C. granulosus*, *C. molluccensis*, *C. atromarginates*, *Deania profundorum*, *Centroselachus crepidater* and *Squalus* spp. landed.
- During the period July to October, the deep sea chondrichthyan landings by drift gillnet and trawl was mainly composed of bramble shark (*Echinorhinus brucus),* followed by chimaera *Neoharriotta pinnata* and gulper sharks (*Centrophorus* spp.). Species of sharks

Catches of deep water oil shark *Centrophorus* sp. at Cochin Fisheries Harbour

Deep water Chimaera *Neoharriotta pinnata* landed at Cochin Fisheries Harbour

Deep sea shrimp *Aristeus alcocki* landed by multi-day trawlers

such as *Hexanchus griseus* (Hexanchidae) and *Deania profundorum* (Centrophoridae) were recorded for the first time from Indian waters. Certain rare sharks such as the seven-gilled shark *Heptranchias perlo* were also observed.

- Deep sea finfishes such as *Cubiceps* spp., *Neoepinnula* spp., *Rexea* spp, *Psenopsis* spp., *Gephyroberyx* spp.,*Chlorophthalmus* spp. etc. occurred as by-catch in the deep sea trawl fisheries and were mostly discarded. Certain species such as *Neoepinnula orientalis* were sold in the domestic market also.
- Chimaera, *Neoharriotta pinnata* is emerging as a targeted fishery. Size range of the specimens landed at Cochin Fisheries Harbour was 55-147 cm.
- In deep sea shrimp fishery, dominant species were *Plesionika spinipes*, *Heterocarpus woodmasoni*, *H. gibbosus*, *Metapenaeopsis andamanensis*, *Aristeus alcocki* and *Solenocera hextii*.
- A training programme on *Acoustics techniques for fish and plankton biomass estimation* was attended onboard FORV Sagar Sampada.

FUNDING AGENCY	**NAIP-ICAR**
PROJECT TITLE	**A Value chain on oceanic tuna fisheries in Lakshadweep Sea**
SCIENTISTS	**E.V.Radhakrishnan,** N.G.K.Pillai, E. Vivekanandan, R. Sathiadas, K. Sunil Mohamed, C. Ramachandran, J. Jayasankar, K.P. Said Koya, U. Ganga (CMFRI); B. Meenakumari, T.K. Srinivasa Gopal, Toms C. Joseph, Suseela Mathew, K. Ashok Kumar, P. Pravin, Reghu Prakash, M.V. Baiju, Bindu J (CIFT), V.S.Somvanshi (FSI) and C.G. Koya, Cheria Koya, Mohamed Koya, S. Hameed (FD LAK)
CENTRE	Cochin, Mumbai, Agatti and Kavaratti

Cadalmin silo feed being released

Agatti fisherman processing tuna at the landing centre

- Project launched on 12 August 2008.
- Collection of tuna landing data using statistically designed proforma from three islands was carried out. An estimated 3725 t of tuna was landed. Yellow fin tuna (*Thunnus albacares)* constituted 1078 t (Lakshadweep).
- Fishery Survey of India conducted two survey cruises of 16 days duration in Lakshadweep Sea. Long line fishing was carried out. 5276 hooks were operated during the first cruise, percentage of hooking rate for Yellowfin tuna was 0.09.
- Baseline socioeconomic survey of three islands (Agatti and Kavaratti – Project areas and Kiltan as control) was completed and report submitted.
- One Pablo boat was modified and fixed with suitable long line accessories and also with an insulated box to facilitate tuna fishing.
- Two 62' tuna longliners COSMOS and OM provided by the Associate partner Sri Vinayaka, Mangalore conducted tuna longline fishing operations.
- Fish feed from tuna waste for cultivable carnivorous fishes under the brand name CADALMIN SILO was developed, tested and released.
- An improved method for Masmin preparation from skipjack tuna was developed. A ready-to-eat product, smoked tuna in oil medium and Masmin powder from Masmin were also produced.

FUNDING AGENCY	**ICAR Network Project**
PROJECT TITLE	**Impact, adaptation and vulnerability of Indian marine fisheries to climate change**
SCIENTISTS	**E. Vivekanandan,** N.G.K. Pillai, K.S. Mohamed, J. Jayasankar, R. Sathiadhas, C. Ramachandran, V.V. Singh, Joe Kizhakudan, H.M. Kasim and K. Vijayakumaran
CENTRES	Cochin, Mumbai , Chennai and Mangalore

Impact of increase in small pelagic abundance on the ecosystem of northwest coast

- Increase in oil sardine abundance along the northwest coast is attributed to increase in seawater temperature and changes in other oceanographic parameters. ECOPATH model with Ecosim simulation developed for northwest coast ecosystem showed that the biomass of oil sardine closely followed the change in fishing effort. The highest increase in biomass (more than 3-times) occurred in the group small pelagic herbivores consisting of oil sardine. This shows that the biomass of small pelagic herbivores in the ecosystem is likely to increase in future (even under very heavy high fishing pressure), which will be reflected in the catch. Simulations further indicate that most other fisheries groups in the ecosystem may not be impacted immediately due to increase in the biomass of small pelagic herbivores.

Temporal changes in the oceanographic parameters and fish catch along the Kerala coast

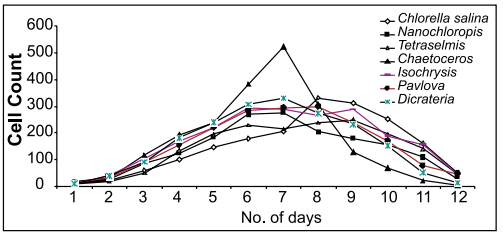
- Monthly average data on oceanographic parameters for the years 1958-2008 along Kerala coast showed significant changes in the trend and increase in anomalies. Analysis of quarterly moving averages of SST, Salinity, Rainfall, Meridional Wind, Zonal Wind and Sea Level showed good correlation with quarterly catches of oil sardine and Indian mackerel. The result will lead further into predicting fish catches.

Effect of seawater temperature on growth, decay and species composition of phytoplankton

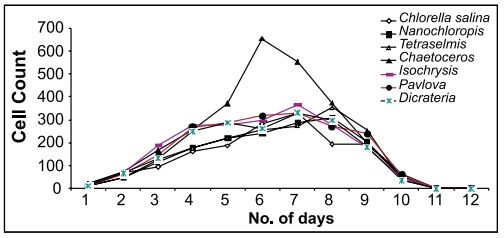
- Laboratory experiments on the effect of seawater temperature on seven marine phytoplankton species showed that the microalgae grew faster at higher temperature (29°C), but the decay set-in earlier than at lower temperature (24°C). The dominance ranking of the microalgae differed between the two temperatures. This shows temperature-related changes in the abundance and species dominance of phytoplankton, indicating potential impacts at the base of food web in the marine ecosystems.

Vulnerability of coastal fishing villages of Maharashtra to sea level rise

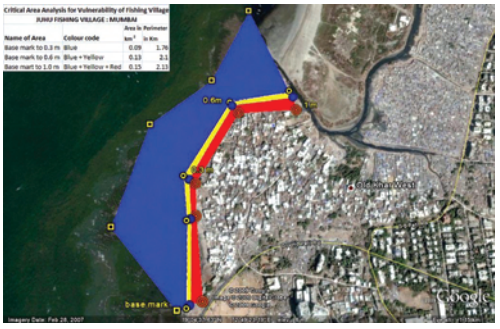
- In Maharashtra, 75 coastal fishing villages are located within 100 m from the high tide line. After geo-referencing these villages, three different Sea Level Rise scenarios were created to determine critical area adjacent to the coast, likely to be submerged. Base mark (0 m), points at 0.3 m, 0.6 m and 1.0 m were obtained through Google Earth Professional software to calculate the perimeter and area for three SLR scenarios. Consolidation of all the maps to identify vulnerable coastal fishing villages in Maharashtra is under progress.



Growth of marine microalgae at 24°C under laboratory condition



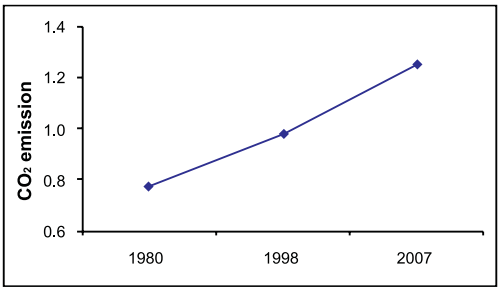
Growth of marine microalgae at 29°C under laboratory conditions



Projected area of inundation of Juhu fishing village, Mumbai for three sea level scenarios; blue colour indicates 0.3 m, blue+yellow 0.6 , blue+yellow+red 1.0 m rise in sea level

Fleet	CO_2 emission
Mechanised boats	1.67
Trawlers	1.79
Gillnetters	1.41
Dolnetters	1.45
Motorised boats	0.48

CO_2 emission (tonnes per tonne of fish catch) by marine fishing boats during 2005-2007

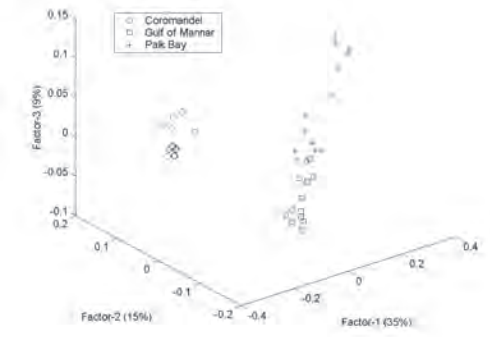


CO_2 emission (tonnes per tonne of fish catch) by marine fishing boats during 1980, 1998 and 2007

Estimation of carbon footprint by marine fishing boats

- It is estimated that annual CO_2 emission of marine fishing boats in India was 3.6 million tonnes during 2005-2007. It was found that the mechanized boats emitted 1.67 tonnes of CO_2 per tonne of fish catch, and motorized boats with outboard engine emitted 0.48 t CO_2 per t of fish catch. Among the mechanised craft, trawlers emitted more CO_2 than the gillnetters and dolnetters. Based on the data available on the number and size of fishing boats in India in the past years, it is estimated that CO_2 emission per tonne of fish caught has increased by 64% in a period of 25 years.

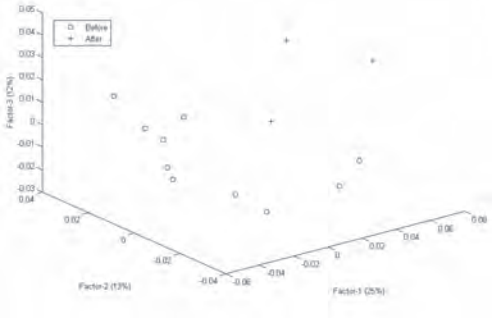
PROJECT CODE MF/IDP/02
PROJECT TITLE Application of trophic modelling in marine fisheries management
SCIENTISTS **K.S. Mohamed,** E. Vivekanandan, T.V. Sathianandan, D. Deshmukh, M.Z. Khan, S.G. Raje, V.V. Singh, Paramita Banerjee, G. Mohanraj, P.K. Asokan, S. Ghosh, V. Venketasan, Bindu Sulochanan, P.U. Zacharia, E.M. Abdussamad, K.K. Joshi and P.S. Asha
CENTRES Cochin, Mumbai, Veraval, Chennai, Mandapam and Tuticorin



Differences in fished taxa biodiversity in CC, PB and GOM as indicated by PCoA.

Studies on impact of Tsunami on fished taxa biodiversity of TN coast

- A database was created in ACCESS with individual species wise estimates of marine fish landings in Tamil Nadu during 1995-2007. Using presence and absence data of different species in three regions – Coromandel Coast, Palk Bay and Gulf of Mannar – ecosystem differences were examined through Principal Co-ordinate analysis. Further, the impact of Tsunami in the three regions was also studied through PCoA.
- Results indicated that fished taxa diversity of Coromandel Coast differs from Palk Bay and Gulf of Mannar. There are significant impacts on fished taxa diversity after Tsunami in Coromendel Coast and Gulf of Mannar, but not in Palk Bay. This is mainly because Palk Bay was protected physically by Sri Lanka landmass, while other two ecosystems were not.



Clear separation of points in PCoA before and after tsunami in Coromendel coast

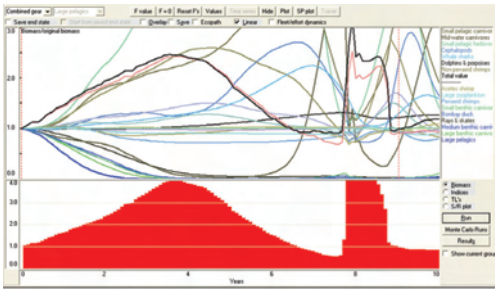
Northwest Coast (NWC) Ecosystem

- The NWC model developed in 2007-08 was used in a simulation exercise using ECOSIM with the objective of studying change in biomass due to the following.
- Rapid increase in effort
- Drastic reduction in effort
- Pulse fishing
- Delineation of sensitive & resilient species
- The results indicated that some of the ecological groups were very sensitive to change in effort, while others were not. The sensitive and resilient species groups were delineated.

Resilient Groups	Sensitive Groups
Penaeid shrimps	Large benthic carnivores
Cephalopods	Small benthic carnivores

Non-penaeid shrimps
Small pelagic carnivores
Small pelagic herbivores
Acetes
Medium benthic carnivores
Rays and skates
Large pelagics
Midwater carnivores
Bombay duck

- The simulation exercise showed the changes in biomass that will take place in the next 10-years on account of increase in effort. With increase in effort some of the large species (large benthic carnivores, large pelagics, midwater carnivores, rays and skates etc.) in the NWC showed decline in biomass and decrease in effort did not result in recovery of their biomasses. On the other hand, groups such as small herbivores showed a consistent increase in biomass even with increase and decrease in effort.



Change in biomass of different ecological groups on account of increase and decrease in effort of all gears during the next 10 years. Effort increase is shown in the bottom panel in red

FUNDING AGENCY **ICAR-AP Cess Fund**

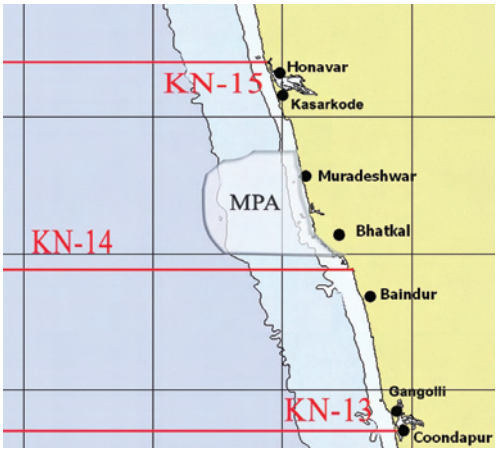
PROJECT TITLE **Assessing the impact of fisheries on the biodiversity of marine fish resources of Southwest coast of India**

SCIENTISTS **K. S. Mohamed,** P.U. Zacharia, T.V. Sathianandan and P.K. Asokan

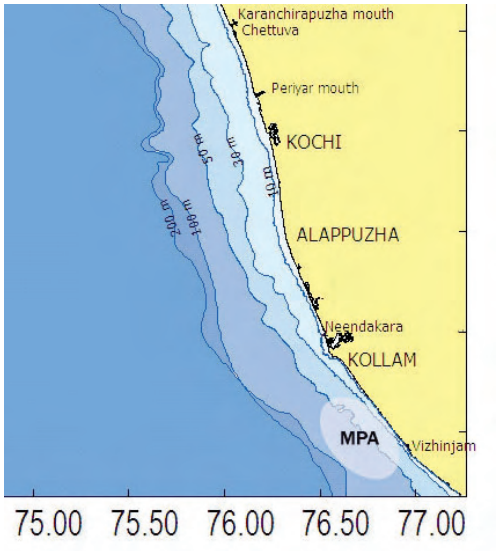
CENTRES Kochi, Veraval and Tuticorin

The final report of the AP Cess Fund project on 'Assessing the impact of fisheries on the biodiversity of marine fish resources of Southwest coast of India' was submitted to the ICAR during the year. The salient findings are:

- Using data archaeology, 2 databases were created – one, a complete fished taxa catch and effort database for Kerala and Karnataka for 1970 to 2005, and another historical records for the Indian oil sardine and mackerel with regard to catch (1926-2005: 80 years) and length frequencies (oil sardine: 1934-2005: 70 years).
- Catches of both oil sardine and mackerel were not having any significant relationships with sunspot activity, ENSO or rainfall. The recruitment success of oil sardine whose spawning and recruitment cycle is overlapping with the upwelling season is depending upon an Optimum Environmental Window.
- The spatial comparison of the data on Average Taxonomic Distinctness (AvTD; Delta+) and Variation Taxonomic Distinctness (VarTD; Lambda+) shows that K1 and K2 zones in Kerala (off Thiruvananthapuram District) and K14 zone (off Bhatkal) in Karnataka are stressed habitats with respect to biodiversity and this may be due to impacts of fishing. Coincidentally, these fishing zones in Kerala also had comparatively poor alpha and beta diversity values. Therefore parts of these fishing zones (K1, K2 and KN14) are identified as MPAs.
- Predictions for Karnataka derived from the Markov Chain analysis indicate that oil sardine and Mackerel are likely to continue and dominate the catches in future also, although oil sardine has higher probability to be at Rank 1 position. The Markov Chain analysis for Kerala reveals that only three resources/ species are predicted to improve their landings – sharks (from 50th rank to between 21 and 25), *P. stylifera* (from 13 to between 1 and 5) and *Stolephorus* (from 11 to 4).



Identified MPAs in Karnataka



Identified MPAs in Kerala

- Four species in Karnataka and 17 species in Kerala were classified as extremely rare or extinct as they have not been recorded in the fishery for the past 20 years. A new criterion for classification of fish stocks as depleted, collapsed and extinct based on percentage of maximum catch was applied, and accordingly, 1 fish stock in Kerala and 2 stocks in Karnataka are considered as depleted. Catfish is a depleted stock common to both states.

Average catch (t) during 2003-2005 of different species as percentage of the maximum catch during 1971-2002 in Karnataka. Those species/ stocks having percent average catch below 5% of maximum catch were considered as depleted. In this manner, both *Arius* sp. and *Upeneus* sp. are classified as depleted in Karnataka.

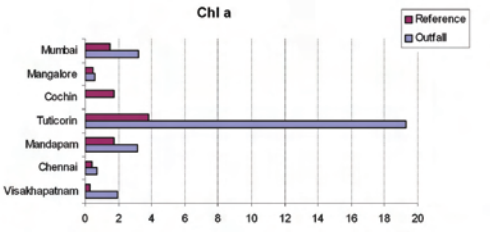
Species	Average catch (t)	Maximum catch (t)	Percent of maximum catch
Sepia. sp.	4619	5958	128.99
Trichiurus sp.	11906	10882	91.40
Nemipterus sp.	24933	18321	73.48
Loligo duvauceli	8220	5859	71.28
Sardinella longiceps	65614	44236	67.42
Hemiramphus sp.	349	220	63.04
Sphyraena sp.	2002	1228	61.34
Caranx sp.	29668	14081	47.46
Leiognathus sp.	11563	4735	40.95
Cynoglossus sp.	18153	7163	39.46
Mugil cephalus	295	84	28.33
Oratosquilla nepa	45159	12631	27.97
Lactarius lactarius	2930	756	25.80
Chirocentrus sp.	784	177	22.58
Rastrelliger kanagurta	101790	20000	19.65
Carcharhinus sp.	4711	775	16.45
Stolephorus sp.	18718	2766	14.78
Pampus argenteus	1077	126	11.70
Metapenaeus dobsoni	27633	2862	10.36
Metapenaeus monoceros	15793	1235	7.82
Arius	**10253**	**293**	**2.86**
Upeneus	**936**	**0**	**0.00**

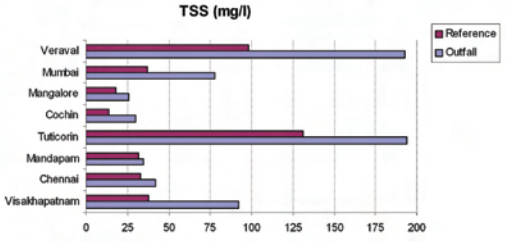
Identification of MPAs in Kerala and Karnataka based on biodiversity stress in fishing zones

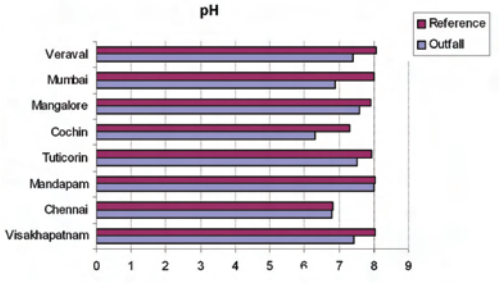
Identified MPA	Landmarks	Part of LME	Taxonomic	Trophic Level Diversity	Remarks
KERALA Parts of Fishing Zone – K1 & K2	From Kollamgode in the south to Kappil in the north	Arabian Sea, could also be a transition zone between Indian Ocean and Arabian Sea	Very poor Delta+ values indicating low taxonomic diversity Poor alpha and beta diversity	Comparatively high trophic level	A predator driven oceanic ecosystem which needs conservation on account of biodiversity stress
KARNATAKA Parts of Fishing Zone – KN14	From Bhatkal in the south to Murudeswara in the north	Arabian Sea LME and part of Malabar Upwelling Zone	Poor Delta+values indicating low taxonomic diversity Poor alpha and beta diversity	Not studied	A habitat with many small rocky islands and submerged coral reefs which needs protection and conservation on account of biodiversity stress

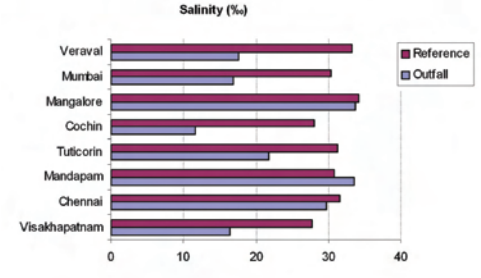
PROJECT CODE	FEM/01
PROJECT TITLE	**Impact of anthropogenic activities on coastal marine environment and fisheries**
SCIENTISTS	**P. Kaladharan,** M. Rajagopalan, P.K. Krishnakumar, P.K. Ashokan, V.V. Singh, K. Vijayakumaran, D. Prema, P.S. Asha and Bindu Sulochanan
CENTRES	Visakhapatnam, Chennai, Veraval, Mumbai, Mangalore, Cochin, Tuticorin and Mandapam

To study the impact of urban domestic sewage and other anthropogenic activities, environmental parameters such as CO_2, pH, SST, BOD, TSS, Salinity, NH_3, dissolved nutrients, primary productivity, chlorophyll pigments and quantity of plastics and other non degradable materials from 32 stations out of 8 coastal centers along the maritime states were monitored monthly.









Salient observations

- Significant reduction in pH at the outfall areas-sewage disposal, fisheries harbour and industrial effluents
- Manifold increase in chlorophyll *a* pigments in sewage outfall area, although primary productivity did not increase proportionately
- Occurrence of dense population of toxic algal species like *Gonyaulax spinifera, Peridinium depressum, Prorocentrum micans* etc in the sewage outfall area
- Occurrence of plastics, nylon and synthetic polymers in fishing grounds is increasing
- Bio-concentration levels of mercury in oysters, clams and crabs from Visakhapatnam, Veraval and Mumbai as well as in finfishes from Tuticorin is well above the WHO permissible levels.
- TSS, and NH_3 levels in seawater were above the limits of effluent standards set by MoA.
- Iron ore handling by the NMPT causes scum in seawater in the vicinity of NMPT jetties.
- Studies using siltmeter showed that corals and sea grass beds in Palk Bay and GOMBR are affected by dredged silt and debris
- Bloom of *Noctiluca scintillans* occured in Rameswaram during October 2008 resulting in massive fish kill.
- Seaspiders found attached to the cnidarians infested on the net mesh of floating cage were identified from Visakhapatnam and documented.

Collected parameters from different locations in India

Centres / Parameters	Domain	Visakha-patnam	Chennai	Mand-apam	Tuti-corin	Cochin	Mangalore	Mumbai	Veraval
CO_2 (mg/l)	Outfall	36.3	0	0	18.65	0	8	145	-
Reference	1	0	0	0	0	3.4	78	-	
NH3 (µg/l)	Outfall	120	1.33	1.162	173	76	-	-	-
Reference	0.4	0.707	0.924	60	1.82	-	-	-	
TSS (mg/l)	Outfall	92	42	35	194	30	26	78	193
Reference	38	33	32	131	14	18	37	98	

BOD (mg/l)	Outfall	0.461	-	Silt (g/l)	0.6	2.384	1.05	1.1	4.7	-
Reference	0.899	-	0.25	0.794	1.6	1.4	3.8	-		
pH	Outfall	7.44	6.8	8.017	7.52	6.3	7.6	6.89	7.41	
Reference	8.04	6.83	8.05	7.94	7.3	7.9	8.01	8.06		
Temp (ºC)	Outfall	29.08	29.2	29.9	28.4	29	28.4	33	32.2	
Reference	28.4	28.6	30.6	29.9	30	28.5	30.2	29		
Salinity (‰)	Outfall	16.4	29.8	33.6	21.7	11.7	33.7	16.9	17.6	
Reference	27.8	31.5	30.75	31.3	28.1	34.1	30.3	33.3		
Chl a (mg/m^3)	Outfall	1.944	0.712	3.16	19.3	0.03	0.6	3.2	-	
Reference	0.299	0.433	1.72	3.83	1.75	0.5	1.5	-		
Plastics in fishing ground (g)		240-300/tr	120/100m^2	125/100m^2	-	4g, 24/100m2	850/tr	-	-	
Hg in sediment (ppm)	Outfall	3.022	0.503	2.09	0.574	2.09	-	3.85	0.92	
	Reference	0.418	0.488	1.53	0.32	1.53	-	1.67	0.18	

PROJECT CODE **FEM/02**

PROJECT TITLE **Impact and yield study of environmental changes on the distribution shift in small pelagics along the Indian coast**

SCIENTISTS **K. Vijayakumaran,** M. Rajagopalan, V. Chandrika, D. Prema, T.V, Sathianandan, U. Ganga, P.K. Krishnakumar, Subhadeep Ghosh, P. Kaladharan, Prathibha Rohit, V.V. Singh, P.S. Asha and Bindu Sulochanan

CENTRES Mangalore, Chennai, Cochin, Veraval, Visakhapatnam, Mumbai, Tuticorin and Mandapam

Hydrography:

- Hydrographic parameters from representative locations at the operative centres ws studied. It could be seen that highest mean surface temperature was recorded at Veraval followed by Mandapam.

Average values of key hydrological parameters of the surface waters of selected stations from different centres

Centre (Region)	Station	SST ºC	pH	Salinity psu	DO ml/l	Chl-a mg/m^3
Veraval (Northwest)	offshore	31.13	7.69	34.89	5.12	Na
Mumbai (Northwest)	Apollobunder	28.78	7.87	32.77	2.02*	Na
Mangalore (Southwest)	10 m stn	29.9	8.0	34.0	4.5	0.3
Cochin (Southwest)	10 m stn	29.6	7.28	23.81	3.66	1.05
Tuticorin (Southeast)	Stn-1	28.92	7.83	31.44	1.99	0.49
Mandapam (Southeast)	Palk Bay	30.2	8.1	29.5	4.1	1.3
Chennai# (Southeast)	N. Kuppam	28.44	7.02	33.5	3.48	Na
Visakhapatnam (Northeast)	Inshore	27.28	7.93	28.43	4.15	0.26

*# Mean of April-August. *mg/l*

- Except the lower average salinity at Visakhapatnam, and lower mean value of dissolved oxygen at Tuticorin, the hydrographic parameter was within the normal range and no special trends or anomalies could be delineated from the available data.

Phytoplankton:

- Nearly hundred species of phytoplankton have been recorded from the eight operating centres of this project. The seasonal occurrence of different species as well as their relative abundance in the plankton community varied greatly. In the case of blooming species, the one time abundance often surpass the total abundance of some most prevalent species for the entire year.

Centre (Region)	No. of Species	Most prevalent species (percentage samples in which the species occurred in the year)
Veraval (Northwest)	38	*Coscinodiscus gigas (40), Striatella delicatula (40), Diploneis puella (40), Lithodesmium undulatum (40), Rhizosolenia alata (40)*
Mumbai (Northwest)	68	*Bacillaria paradoxa (47), Nitzschia sigma (47), Nitzschia longissima (40), Navicula distans (40), Navicula clavata (33), Pleurosigma elongatum (33)*
Mangalore (Southwest)	61	*Navicula distans (50), Ceratium tripos (38), Thalassiosira subtilis (38), Cyclotella striata (38), Nitzschia sigma (38)*
Cochin (Southwest)	79	*Skeletonema costatum (100), Biddulphia sinensis (60), Bacillaria paradoxa (40), Thalassiosira subtilis (40), Chaetoceros peruvianus (40)*
Tuticorin (Southeast)	66	*Biddulphia mobilensis (35), Biddulphia sinensis (29), Skeletonema costatum (29), Mastogloia exilis (29).*
Mandapam (Southeast)	60	*Eucampia cornuta (21), Striatella delicatula (21), Thalassiosira subtilis (21), Planktoniella sol (21), Skeletonema costatum (21), Aulacodiscus* sp.*(21)*
Chennai (Southeast)	66	*Rhizosolenia alata (67), Rhizosolenia robusta (67), Biddulphia sinensis (50), Cyclotella striata (50), Planktoniella sol (50)*
Visakhapatnam (Northeast)	67	*Biddulphia sinensis (43), Navicula distans (43) Skeletonema costatum (36), Nitzschia sigma (36), Surirella fluminensis (36)*

- On an average, all the centres recorded between 60-70 species except at Veraval (where the number of species recorded were 38) and at Cochin (79 species). The diversity of phytoplankton species and the wide range of hydrological conditions would pose immense challenges in deriving a spatial and temporal distribution pattern amenable for comparisons.
- It could be noticed that similarities in the plankton from centres of the same region are wanting. However, *Skeletonema costatum* was dominant in the three centres of the southern peninsular region (Cochin, Tuticorin and Mandapam), while *Biddulphia sinensis* was common in the samples of Cochin and Tuticorin.

Zooplankton:

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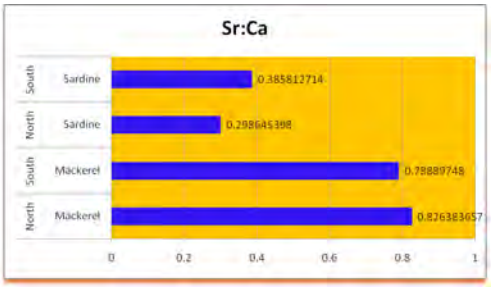


Strontium: Calcium ratio in sardine and mackerel from south and north coasts of India

Percentage incidence of most common plankton groups in samples

Centre (Region)	No. of Groups	Copepods	Decapods	Lucifer	Chaeto-gnaths	Fish eggs	Fish larvae	Others
Veraval (Northwest)	12	100	100	40	60	60	80	60[1]
Mangalore (Southwest)	15	100	60	100	80	70	80	70[2]
Cochin (Southwest)	10	91	91	91	55	36	64	45[3]
Tuticorin (Southeast)	16	92	100	92	92	75	0	58[4]
Mandapam (Southeast)	9	61	72	50	72	0	28	17[5]
Chennai (Southeast)	13	100	83	100	100	83	17	50[6]
Visakhapatnam (Northeast)	17	58	25	17	50	33	8	25[7]

1: Amphipoda 2: Appendicularia, 3: Hydrozoa, 4:Stomatopoda, 5:Hydrozoa, 6: Hydrozoa & Siphonophora, 7: Mysids

- It could be noticed that copepods were the most dominant group in the zooplankton samples from all centres except Tuticorin and Mandapam where decapods were the dominant group. The four most common items were present in all the centres indicating the system's diversity for adapting to changes. However, the quantitative aspects are more important to deduce the sufficiency of these organisms to support a small pelagic stock. Significant insights could be gained by additional observation on plankton from different centres.

Truss Morphometry:

- Truss data was collected from all the centres for sardine and mackerel during the present period. A preliminary analysis has revealed that mackerel from Veraval was different from that of Mandapam and Visakhapatnam. Further analysis is required and final conclusion could be made based on the supporting evidence from genetic studies.

Stomach Content:

- The stomach contents of mackerel and sardine were analysed during the period. The dominant phytoplankton in the food of both mackerel and sardine was *Coscinodiscus* sp. The dominant zooplankton item was copepods. It could be presumed that the food organisms of sardine and mackerel may not be a limiting factor restricting their distribution

Otolith Chemistry:

- Otolith morphology of oil sardine from east and west coast was similar, but that of mackerel varied with sampling location. The Strontium: Calcium (Sr : Ca) ratio showed slight variations from centre to centre, but the ANOVA revealed the variations as not significant. A region-wise analysis of the otolith chemistry revealed significant difference in the Sr : Ca ratio of sardine from south and north, while the difference in the Sr : Ca ratio of mackerel of south and north were not significant.
- On the other hand a comparison of Sr : Ca ratio based on the east and west coast of India revealed the difference among sardine and mackerel of the two coasts area almost similar. This could be indicative of the difference in the stocks distributed along the Indian coast. Since the number of samples was very few, there is a need for further analysis with more samples to confirm this fact.
- Salinity showed a positive correlation with Sr: Ca ratio. Though spatial variation was observed in the Ba:Ca and Mg:Ca ratios also, it is premature to say conclusively on the environmental relations.

FUNDING AGENCY	**Ministry of Earth Sciences**
PROJECT TITLE	**Studies on marine mammals of Indian EEZ and the contiguous seas**
SCIENTISTS	**E. Vivekanandan,** P.P. Manojkumar and K.P. Said Koya
CENTRES	Cochin and Calicut

Stenella longirostris off Dwarka (22.02 °N 67.00 °E), 23-3-2009

Cochin backwater surveys

- A boat-based survey in Cochin backwaters was undertaken aboard an outboard-engine boat (overall length 7m). The objective of the survey was to study the occurrence and abundance of marine mammals in Cochin backwaters based on sighting and photo-identification. Eleven short surveys, each with duration of two hours, were carried out during the period from May to August 2008. Dolphins were sighted on six occasions and the animals were identified as Indo-Pacific humpback dolphin, *Sousa chinensis*. The area appeared to be a good feeding and socializing ground for the animal, which has the potential for benign ecotourism for dolphin watch.

Survey onboard FORV Sagar Sampada

- From April 2008 to March 2009 participated in 6 cruises of FORV *Sagar Sampada* in the Indian EEZ and the contiguous seas. Considerable data on cetacean occurrence and diversity were generated during the survey. The total number of days spent onboard FORV *Sagar Sampada* was 119 days. About 795 hours of effort was put in for observing marine mammals and a distance of about 5469 nautical miles were surveyed during the period. A total of 79 sightings of whales and dolphins were recorded, which comprised of about 1899 individuals. *Stenella longirostris* (spinner dolphin) was the most frequently sighted species showing a wide distribution. *Delphinus capensis* (longbeaked common dolphin), *Sousa chinensis* (Indo-Pacific humpback dolphin) and *Tursiops aduncus* (Indian Ocean bottlenose dolphin) were also sighted frequently. Species such as *Physeter macrocephalus* (sperm whale), *Grampus griseus* (Risso's dolphin) and *Pseudorca crassidens* (false killer whale) were also recorded on a few occasions. The high frequency of occurrence of blue whale (*Balaenoptera musculus*) along the southern Sri-Lankan waters showed that the area is a hotspot for blue whales.
- An important sighting recorded during the period was that of *Indopacetus pacificus* (Longman's beaked whale). This is the first confirmed sighting of the species from the southern Bay of Bengal.

Grampus griseus off Cannanore (11.58 °N 74.21 °E), 11-10-2008

Indopacetus pacificus in Southern Bay of Bengal (6.18 °N 85.50 °E), 28-1-

PROJECT CODE	**SEE / PEM/ 01**
PROJECT TITLE	**Benefit Cost Analysis of Marine Fishery Business Enterprises and Aternative Investment Options**
SCIENTISTS	**R.Narayanakumar,** R.Sathiadhas and N.Aswathy
CENTRE	Cochin

- The estimated value of the total marine fish landings at landing centre level (primary market) increased from Rs.13, 287 crores in 2006 to Rs.17,133 crores in 2008, registering an increase of 28.9%. At the retail market level, the value increased from Rs.22,236 crores in 2006 to Rs.24,934 crores in 2008 showing an increase of 34.6%.
- The percentage share of fishermen in consumer rupee has increased over the years, indicating an improvement in marketing efficiency. The percentage share of fishermen in consumer rupee (PSFCR) ranged from 40% for oil sardines to 80% for seer fish. But, wherever Self-Help Groups (SHG's) or Co-operative fish marketing existed, PSFCR was found to be consistently above 70% for all varieties
- In the primary market, average landing centre price ranged from Rs.14/ kg for silver bellies to Rs.180/kg for seer fishes and the average retail market price ranged from Rs.30/kg for silver bellies to Rs.250/kg for pomfrets in the domestic marketing system.
- The marketing margins of quality fishes and exportable varieties are comparatively less and stable in the internal marketing system. The demand for fish in the internal marketing system is increasing over the years.
- Out of the estimated gross income of Rs.17,133 crores generated from fisheries in 2008, mechanized sector contributed Rs.12,850 crores (75% of the gross income), motorized sector, Rs.3,598 crores (21%) and non-mechanized sector, Rs.685 crores (4%).

- The estimated gross investment in fishing crafts and gears (2008) is Rs.13,392 crores out of which the investments in the mechanized sector worked out to Rs.11,439 crores (85% of the gross investment), motorized sector, Rs.1,210 crores (10%) and non-mechanized sector, Rs.688 crores (5%).
- The factor productivity analysis indicated that at national level, fuel and crew wage accounted for 86-90% of operating cost/trip for all mechanized fishing operations during 2008 indicating the need for optimizing the use of fuel and labour.
- The break-even price (BEP) per kg of fish worked out at Rs.32.78 for mechanized crafts, Rs.20.33 for non-mechanized and Rs.17.25 for motorized crafts (2008). The average value realized per kg of fish was worked out to Rs.62.82 for mechanized crafts, Rs.30.38 for non-mechanized and Rs.23.35 per kg for motorized craft's catches.
- In single day trawl fishing (SDF), 72 % of the fishermen operated between 60 and 90% efficiency level.
- The average gross earnings of a single day trawler worked out to Rs.5,050, generating net operating income of Rs.1,672 per trip in Kerala with a capital (K) productivity of 0.66.
- The multi-day fishing (5-10 days) in trawling operated at the highest technical efficiency of 94.5 %, which indicated that there is very little scope to increase their efficiency further.
- The multi-day trawler of 5-7 days per trip in Kerala earned gross earrings Rs.71,747 as against variable cost of Rs.40,285 realizing a net operating income of Rs.31,462 per trip with a K of 0.56.
- In multi-day (3-5 days) trawl fishing, the capital productivity was highest at Kakinada (0.48) followed by Bhiaravapalem (0.61) and Paradeep (0.73). The labour productivity was also the highest in Kakinada (127kg/crew/trip), followed by Bhairavapalem (106kg/crew/trip) and Paradeep (100kg).
- Motorized gillnet in Tamilnadu with 3 crew members in a plank built (PB) boat earned gross revenue of Rs.1,050 as against fuel expense of Rs.400 and with a capital productivity of 0.38.
- The hook and line in motorized units of 5 days operation earned on an average Rs.18,718 as against operating expense of Rs.14,662, thus earning a net income of Rs.4,056. The capital productivity was 0.78.

PROJECT CODE	**SEE / PMS / 01**
PROJECT TITLE	**A diagnostic study on dimensions, causes and ameliorative strategies of poverty and marginalisation among the marine fisherfolk of India**
SCIENTISTS	**C.Ramachandran,** R.Sathiadhas, Vipinkumar.V.P, Sheela Immanuel, Swathilekshmi.P.S
CENTRES	Kochi, Mangalore and Visakhapatnam

- The extent of poverty and marginalization across traditional, motorized and mechanized sectors in Kerala, Tamil Nadu, Andhra Pradesh and Karnataka are being studied on a diachronic basis (2008-2012).
- A methodology was developed to capture the diachronic nature of the poverty using a participatory approach.
- The FGT (Foster, Greer and Thorbecke) index was worked to have a preliminary idea on the poverty gap. The percentage of people

below poverty line (BPL) belonging to the traditional sector was worked out based on the PPAR from the four states, is compared below. The total people below poverty line was estimated based on the sample per cent of the poor and utilizing the Marine Fisheries Census (2005) data. It was found that the state average figures for BPL families were much above the sample estimates.

- The findings indicated that the discourse on poverty needs to be refocused on issues of relative poverty in the context of distributional inequalities.
- An examination of the health parameters indicated that there was an increasing penetration of diseases like high blood pressure, coronary problems, high blood sugar and related ailments among the traditional fisher folk.
- A typical traditional fisherman's family spends about 45.8 to 54.2% of his income on non-food items.
- The indebtedness ranged from Rs.8,912-Rs.47,561 (across the states average).
- PDS dependence was found to be high across the states and about 72% of the respondents in Kerala recorded unsatisfactory performance of PDS. The Tamilnadu fisher folk registered maximum satisfaction (89.88%) on this count.
- The school drop-outs was found to be maximum in Andhra Pradesh (21.34%) followed by Karnataka (20.1%) Tamil Nadu (19.6%) and Kerala (7.2%). Adoption of birth control measures was found to be high in Kerala (84.6%), followed by Tamil Nadu (73.2%), Karnataka (69.1%) and Andhra Pradesh (67.8%).

Poverty head count using the PPAR in the traditional sector

State	Sample a(n)	n poor	Sample poor (%)	Census N	N state poor	Estimated poor	State per cent
Kerala	928	57	6.2	9,522	1,428	584	15.0
Karnataka	911	114	12.55	7,577	1,894	9,48	25.0
Tamil Nadu	934	94	10.1	24,231	5,452	2,438	22.5
Andhra Pradesh	929	91	9.8	24,386	3,852	2,388	15.8

PROJECT CODE	**MBD/RE/01**
PROJECT TITLE	**Understanding the threatened coral reef ecosystems of southern India and designing interventions aimed at their restoration**
SCIENTISTS	**Mary K. Manisseri,** Molly Varghese, K. Vinod, T. S. Naomi, Rekha J. Nair, N.K. Sanil, Rani Mary George, S. Jasmine, V.S. Kakati, Miriam Paul Sreeram, K.K. Joshi, Sujitha Thomas, Sandhya Sukumaran, K. S. Sobhana, P. S. Asha
CENTRES	Cochin, Vizhinjam, Karwar, Tuticorin, Mangalore and Mandapam

- Four underwater surveys were conducted for documentation of the resources under study on a GIS platform. Line Intercept Transect method was adopted for the study of coral cover and biodiversity. Underwater photography and videos were taken to assess the bioresources of the area.
- Underwater survey was conducted at Tuticorin Harbour area during during January 2008. Twenty species of hard corals were recorded. The live coral cover was dominated by Acroporids followed by

Brown band syndrome

Sand doller *Clypeaster reticulatus*

Seaurchin *Stomopnuestes variolaris*

Montipora and Faviids. Almost 65% of the transect area was dominated by dead corals.

- Fifteen species of hard corals under 6 genera were identified from 4 sites at Netrani Island in Karnataka. A total of 70 species of marine fishes belonging to 19 families were recorded in the coral reef ecosystem using underwater visual census technique of belt-transect. Fishes of the family Balistidae dominated (22 %) followed by Pomacentridae (12.5 %); 9 species of bivalves belonging to 6 families and 25 species of grastropods belonging to 17 families were also recorded. Diversity indices were worked out.
- Underwater survey was conducted at 3 sites in the coral reef ecosystem around Grande Island, Goa during April 2008 and 13 species of hard corals were recorded. Percentage coral cover by different species and diversity indices were worked out. *Turbinaria* spp. and *Dendrophyllia* spp. dominated. Analysis of coral fish assemblage showed 19 species belonging to 14 families, with Pomacentridae dominating the community. Underwater survey was conducted in the Palk Bay Sea during August 2008. The live coral cover (%) was measured using Line Intercept Transect Method at selected sites in the reefs of Palk Bay and compared with the survey conducted in 2004. The average decrease in the coral cover observed was from 41 to 13%. Alterations in community structure was also noticed in this region. Studies on the disease prevalence in hard corals indicated more incidences of diseases in massive corals as compared to branching corals. Disease conditions such as brown band disease, porite ulcerative syndrome, white pox syndrome and pink line syndrome were observed.
- Eighteen samples of sponges collected during the underwater survey in the Palk Bay, were analysed. A large number of sponges were found to be damaged through the operation of mini trawl by local fishermen. Majority of the sponge fauna belonged to Demospongiae. Four species of sponges collected from Vizhinjam waters were identified by extracting spicules (*Sigmadocia fibullata, S. petrosiodes, Petrosia testudinaria and Callyspongia fibrosa*). Four species of soft corals, collected during the underwater survey in the Palk Bay and 2 species collected off Tuticorin were identified by extracting sclerites.
- Seven specimens of *Holothuria* were collected off Tuticorin and identified by separating the radial and inter-radial pieces of calcareous ring and spicules. Juvenile sea cucumbers showed marked variations in the morphology and structural characteristics of spicules. Trawler discards at Rameswaram and Pamban included considerable quantities of echinoderms. A total of 30 species of coral reef fishes, landed by a variety of gears were identified from the coral reef ecosystem off Tuticorin. Of these, 10 species contributed to ornamental fishery, 9 to fishmeal industry and 11 were utilized for human consumption. Studies on the biodiversity of ornamental fishes showed that Lutjanidae with 7 species dominated the local landings at Vizhinjam. Coral reef fish landings by different gears was monitored from 5 centres at Mandapam. A total of 105 species belonging to 46 families were collected, identified, catch statistics and biological characteristics were recorded

PROJECT CODE	MBD/RE/04
PROJECT TITLE	**Species variation and biodiversity of the fishes of the family Lutjanidae of India**
SCIENTISTS	**K.K. Joshi,** Rani Mary George, S. Jasmine, Sujitha Thomas, V.S. Kakati, Miriam Paul Sreeram, T. S. Naomi, K. Vinod, Rekha J. Nair, Molly Varghese and E.M. Abdussamad
CENTRES	Tuticorin, Vizhinjam, Mangalore, Karwar, Cochin, Mandapam and Tuticorin

- Specimens of 26 species of the family Lutjanidae were collected from the landings by different gears at the selected centres (Table). Number of species collected and identified in the present study constituted 40% of the globally available species.
- Species richness was maximum in the case of *Lutjanus russelli* and *L. lutjanus* as compared to other species.
- Among the different genera *Lutjanus* has been found to be the most diverse group with high values of diversity indices of Shannon (2.4-2.8), Simpson (0.88 - 0.94) and Margalef (2.16 -3.50). Genus *Aphareus* was the least diverse group with low values of diversity indices of Shannon (0.59-0.69), Simpson (0.40 - 0.50) and Margalef (0.37 - 0.51).
- Information has been gathered on distribution, synonyms, morphometric characteristics, meristic data and biological characteristics of all the 26 species collected so far.

Lutjanus fulvus

Species collected from different centres

1. *Aphareus rutilans* Cuvier, 1830
2. *Aprion virescens* Valenciennes, 1830
3. *Etelis carbunculus* Cuvier, 1828
4. *Lipocheilus carnolabrum* (Chan, 1970)
5. *Lutjanus bohar* (Forsskal, 1775)
6. *L. gibbus* (Forsskal, 1775)
7. *L. argentimaculatus* (Forsskål, 1775)
8. *L. analis* (Cuvier and Valenciennes, 1830)
9. *L. johnii* (Bloch, 1792)
10. *L. fulvus* (Schneider, 1801)
11. *L. kasmira* (Forsskal, 1775)
12. *L. bengalensis* (Bloch, 1790)
13. *L. decussatus* (Cuvier, 1828)
14. *L. fulviflamma* (Forsskal, 1775)
15. *L. lineolatus* (Bloch, 1790)
16. *L. malabaricus* (Bloch, 1801)
17. *L. monostigma* (Cuvier, 1828)
18. *L. guilcheri* (Fourmanoir, 1828)
19. *L. sanguineus* (Cuvier, 1828)
20. *L. lutjanus* (Bloch, 1790)
21. *L. russelli* (Bleeker, 1849)
22. *L. vitta* (Quoy and Gaimard, 1824)
23. *Paracaesio sordida* Abe and Shinohara, 1962
24. *Pinjalo pinjalo* (Bleeker, 1850)
25. *Pristipomoides filamentosus* (Valenciennes, 1830)
26. *P. sieboldii* (Bleeker, 1857)

PROJECT CODE	**MD/IDP/01**
PROJECT TITLE	**Technology Development for seed production of Shellfish**
SCIENTISTS	**K.R.Manmadhan Nair,** V.Kripa, Reeta Jayasankar, K. K., Vijayan, Josileen Jose, E. V. Radhakrishnan, Shoji Joseph, P. Muthiah, T.S.Velayudhan, I. Jagadis, Joe Kizhakudan, D., Kandasamy, Margaret Muthu Rathinam and P. Vijayagopal.
CENTRES	Mandapam, Tuticorin, Chennai, Calicut and Cochin

Seed Production of shrimp *Penaeus semisulcatus*

- Nauplii produced - 16.32 million
- PL - 8.82 million
- Average survival rate - 56.3 %
- PL sea ranched - 8.13 million

Induced maturation experiments done on blue swimmer crab *P. pelagicus*

- By feeding with wet feeds – Sardine, Clam meat, Squid meat & Cuttle fish meat (50% -80% Maturation & spawning)
- By feeding with formulated pelleted feed. (Maturation & Spawning response very low (30% spawning)

Seed Transportation

- Hatchery produced shrimp *P. semisulcatus* & crab *Portunus pelagicus* seeds were transported from Mandapam to Calicut, survival - 73% (shrimp larvae 2040/lit)
- Crab larvae

  a) 30000/lit - 6.8%

  b) 20000/lit - 16.5%

  c) Baby crabs - 51% [160/lit]

Berried *Portunus pelagicus*

Sand & Spiny lobsters

High density larval rearing with >50% survival at each stage up to P IV.

- One batch with 100% water exchange. SR 60-50-30-20-3%.
- One batch with ampicillin treatment given to live feed. SR 70-60-50-30-2%.
- One batch with live feed gonad tissue as feed and ampicillin treatment. SR within one m 80-70-50-40-20%.
- One batch in raceway system with 1000% water exchange, live feed hepatopancreas as feed. The survival rates were 95-90%, beyond P II stage, larvae developed luminescent bacteria infection which resulted in total mortality.
- Luminescent bacterial infection was found to be very severe in the moulting stages and this greatly hampered the progress of larval rearing.
- In high density systems for accelerating the moulting process, the size of the *nisto* obtained from transformation of P IV was found to be consistently smaller.
- Scyllarid larval rearing requires continuous marine conditions with temperature being maintained at 25-26^{0}C.

Molluscan seed production

- Scallops which were found to co-occur with pearl oysters were collected and maintained in the lab and farm for seed production.
- Pearl oyster conditioning: Maintained under mixed culture feeding, predominantly of *Chaetoceros* spp.
- Spawning experiments: Conducted during the period showed differential settlement and survival in various periods in an year.

Scallops

Pearl oyster *Pinctada fucata*

- Poor settlement during April, May, July & August when high salinity range (36-39ppt) was observed in the bay water. 5-10,000 nos/tank.
- Spawning during November '08 - profuse settlement 50-75,000 nos/tank (4.0 lakh - 0.5mm size) when the environmental parameters were favourable (Salinity range 29-33ppt (Nov); Dec. 31-32ppt) - about 2.0 lakhs reached a size of 2-3 mm (Feb'09).
- Micro algae (*Isochrysis galbana* (ave. con. 2.0 million cells/ml) and *Chaetoceros* spp (ave. con. 1.0m.cells/ml)) were produced on mass scale. Stock culture of 10 species were maintained. Average of 2.0 t /month of mass culture was supplied to hatcheries.

Cowry shell

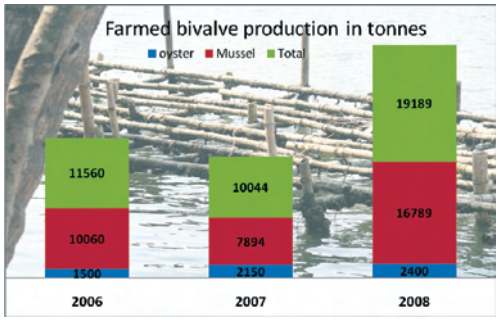
- Inventorisation of cowry species available in the Tuticorin area were made. Six species of cowries were collected and identified.
- In order of dominance they were *Cypraea arabica* > *C. caurica* > *C. ocellatus* > *C. caputserpentis* day old veliger.
- Brood stocks of 4 species of *Cypraea* maintained along with rocks with algal mats. *Cypraea arabica, C. caurica*, *C. ocellatus* and *Cypraea spp.*
- In the order of survival they were *C. caurica* > *C. arabica* > *C. ocellatus* and *Cypraea* sp.
- Observations on the captive egg laying was made for *C. caurica.*
- Captive cowry shells (*Cypraea caurica*) laid eggs on the side of the glass aquarium, eggs were laid one by one through the siphon in between the antennae and in clock wise direction on a circular manner and the process continued for 4 days.135 individual egg cases and each containing 20-25 developing embryos. After two weeks hatching occurred. Hatched veliger measured 480- 500µ size. Larval growth could be monitored only up to 5th day of post hatch. Subsequently mortality occurred.

Clam hatchery

- Spawning of *Paphia malabarica* 26 lakh larvae were reared.
- On21st day 2 lakh seed were produced and had grown to 3mm (1.5 - 4.5) in 2 months.
- On attaining mean size of 9.2 mm the seed were used for farming trials.

Paphia malabarica spat

PROJECT CODE	**MD/IDP/02**
PROJECT TITLE	**Development of diversified mariculture systems (MD/IDP/02)**
SCIENTISTS	**V.Kripa,** P. Muthiah, I. Jagadis, T.S.Velayudhan, K.S.Mohamed, Rita Jayasankar, K. Manmadhan Nair, P. Laxmilatha, P.K.Asokan, Anil M.K, Geetha Sasikumar, Gulshad Mohamed, Joe Kizhakudan, Ritesh Ranjan, C.Kalidas and Bindu Sulochanan
CENTRES	Tuticorin, Cochin, Calicut, Vizhinjam, Mangalore, Veraval, Chennai and Mandapam



Molluscan culture

Farmed bivalve production

- The farmed bivalve production in the country in 2008 was 19,189 tonnes indicating an increase of 91% over that of previous year (10090 tonnes in 2007).
- The major increase in production was due the enhanced production of farmed mussel, 16, 789 tonnes which is 2.1 times higher than the production in 2007 (7894 tonnes).
- Farmed oyster production was 2400 tonnes which is 11.6% more than the production of 2007 (2150 tonnes).

Oyster culture

- At Calicut, rens and shells of *P.malabarica* and *M.meritrix* were placed for spat collection. Good settlement was obtained on the three cultch materials and 4000 spat on clam shells were stocked in cages for single oyster culture.

Clam culture and stock enhancement programmes

- At Tuticorin, the survival and growth of *P.malabarica* seed produced in the hatchery farmed by the on-bottom and off-bottom method was monitored.
- An experiment was conducted to revive the clam population of Tuticorin Bay by transplanting seed of *Donax cuneatus* and *P.malabarica*. More than 90% of the clam biomass of the bay was destroyed due to sudden deterioration of water quality for 3 to 4 days in February, 2008.

Mussel Farming

- Two racks of 14 x 5 m & 12 x 6 m (142 sq m) were fabricated in the outlet of a *Fenneropenaeus indicus* farm near Saligrama, Karnataka at 1.5 m depth (during low tide). About 450 numbers of 0.75 - 1 m coir ropes were seeded with green mussel, *Perna viridis* at the rate of 750 g/m by the last week of December, 2008. The green mussels had a monthly growth rate of 8 mm.

Pearl culture

- Oyster survey : Survey for pearl oyster revealed a new oyster bed with good population of pearl oyster in the region off Pullavel (N. 8° 41' 21.6" E. 078° 09' 52.9") .The depth range of the area is 3.0 to 4.5 fathoms. About 1,500 oysters (50-55mm/30.2-39.4g) were collected during October '08 and transplanted to farm.
- **Pearl production through tissue culture**: For the production of tissue cultured pearls experiments were conducted in TD flasks and tissue culture tubes. Experiments were conducted with round and

Farmers and fisheries officials interacting with oyster farmers and CMFRI staff at Sattar Island

hemispherical beads to measure the thickness of nacre. The measurement of thickness of nacre growth was difficult to find out on round beads. Hence experiments were started on half beads. The cultures with explants on hemispherical beads also developed pearl sacs.

- Explant cultures were conducted to utilize the cells for organ cultures. Numerous cells were proliferated from explant cultures. The free cells were collected and centrifuged. The mass of cells were inoculated over the beads at the rate of $3x10^4$, $5x10^4$, $80x10^4$cells/bead. Growth process and pearl sac formation was noticed after inoculation. Cultures were maintained for nacre growth studies
- In the pearl oysters farm at Harbour, barnacle was found to be the major fouler with a highest settling intensity (per 10 cm^2) of 91.2 g in the first 1.5 m depth followed by 42 g in 3 m depth and 4 g in 4.5 to 6 m depth.

Finfish culture

- At Vizhinjam, pilot scale culture of *Caranx sexfasciatus* was carried out. Juveniles of *C. sexfasciatus* 950 numbers, average size 81.7 mm TL and 7.8g wt caught in the shore seines were stocked in the cage of 20 sq.m attached on to wooden raft. The stocked fishes were fed with anchovies @ 5-7% of body weight . The fishes were harvested after 10 months, the stocked fishes reached an average length of 303mm and 563g wt. Survival was 84% and the study indicated good potential for cage culture.
- A cage of 2m x 2m was fabricated and integrated with the pearl oyster farm at Vellapatti village near Tuticorin. Groupers of length 10 to 29 cm and 25 to 200 g weight were stocked in the cages. The fishes were fed with trash fish and crab @ 5% of total fish biomass. The farm was also stocked with pearl oysters implanted with images for mabe pearl production. Pen culture of *L. argentimaculatus* was initiated at Calicut.

Seaweed mariculture:

- At Kochi, integrated farming of seaweed and shrimp was carried out in the farmer's field during monsoon. The seed introduced in April were harvested during July. The shrimp grew to 18 g size during harvest within 90 days of culture period.
- At Navibunder in Gujarat, *Hypnea valentiae* was cultured, a 5.8 fold increase in yield was obtained during August-September and slightly lower yield during other crop periods. *Hypnea musciformis* was farmed at Chorwad and a 5 fold increase in yield was obtained during August-September.

Lobster culture :

- Experiments on high density culture of sand lobsters of 4-5 g, 10-15 g and 30-50 g were conducted; the optimum stocking density were obtained as 100 nos/sqm, 20-40 /sqm and 10-20 /sqm respectively.

Polyculture of sand lobsters:

- Polyculture of sand lobster juveniles with the white shrimp *Fenneropenaeus indicus* indicated compatibility of the two species, as they co-existed without competition for food or space.

Integrated farm at Vellapatti, near Tuticorin

CMFRI staff demonstrating mussel culture at Karnataka

- Polyculture of sand lobster juveniles with Black tiger shrimp *Penaeus monodon* indicated compatibility of the two species, as they co-existed without competition for food or space in a low density stocking system (10/sq.m *T. orientalis* + 5-10/sq.m *P. monodon*).
- In another system (30/sq.m *T. orientalis* + 5-10/sq.m *P. monodon*) it was found that after the shrimp attain 8 g size, they compete with the lobster for food and even attack the lobsters, feeding on them. The growth rates of both the shrimps and the lobsters were affected by this.
- Polyculture of sand lobster juveniles with mullets in a cement tank system did not pose any problem as the two species were found to co-exist without competition provided there is enough space for the fish to grow.

PROJECT CODE	**MD/IDP/03**
PROJECT TITLE	**Development of broodstock, captive breeding and seed production techniques for selected marine foodfishes and ornamental fishes**
SCIENTISTS	**G. Gopakumar,** Ritesh Ranjan, C.Kalidas, M.K. Anil, Grace Mathew, K. Madhu, Rema Madhu, Boby Ignatius, Kajal Chakraborthy and P.Vijayagopal
CENTRES	Mandapam, Vizhinjam and Cochin

Cobia broodstock in cages

Mandapam

- A 5 metre x 5 metre HDPE cage was fabricated for broodstock development of Cobia was experimented and successfully maintained in healthy condition.
- 5 numbers of circular cages of diameter 6m and 3.5m depth were fabricated and floated in November, 2008 at Mandapam for broodstock development of finfishes.
- Broodstocks of 15 numbers of Cobia (*Rachycentron canadum*) of size 3-15 kg, 50 numbers of Pompano (*Trachinotus blochii*) of size 0.5-2.0 kg and 16 numbers of grouper (*Epinephelus malabaricus*) of size 1-7 kg were developed in the cages.
- Broodstocks of the following species of marine ornamental fishes were maintained and experiments on scaling up of seed production were carried out.

Pomacentrus caeruleus	– Blue damsel
Dascyllus aruanus	– Humbug damsel
D. trimaculatus	– Three spot damsel
Neopomacentrus nemurus	– Yellow tail damsel
Amphiprion sebae	– Sebae clown fish
Chromis viridis	– Green damsel fish
Amphiprion percula	– Percula clown fish

- Seed production of the Sapphire devil damselfish *Chrysiptera cyanea* was standardized.

5 metre x 5 metre cage with HDPE pipe for Cobia broodstock

Vizhinjam

- A new raft of 20 feet x 16 feet which can hold 4 cages of size 250 cm X 200 cm was added.
- 15 numbers of the grouper, *E. malabaricus* of size 2-16 kg, 10

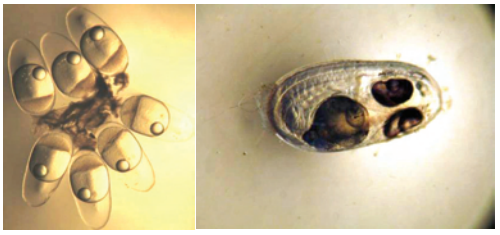
numbers of *E.tauvina* of size 1-3 kg and 35 numbers of Cobia (*R.canadum*) of size 1- 6 kg were stocked in the cages .

- *Ad libitum* feeding with sardines, carangids, squids, prawns were given along with feed supplements such as Vitamins and fish oil capsules

Circular cages of diameter 6 m and depth 3.5m

Cochin

- Broodstock development of tomato clown, *Amphiprion frenatus*, Moon wrasse- *Thalassoma lunare* and Cleaner wrasse *Labroides dimidiatus* were carried out.
- Hormone administration was done for different size groups of *L.dimidatus* and the histological study of gonads showed that the fishes developed ova within eight months.
- Standardization of juvenile rearing of *P.biaculeatus* was achieved.
- Broodstock development and spawning was achieved for Moon beam angel *Centropyge*. Different size groups were reared for broodstock development. The fishes showed spawning behaviour on the day of full moon after rearing for about 4 months.
- Broodstock development and captive breeding of Redhead *Pseudochromis dilectus* (Family *Pseudochromidae)* was achieved. Different experiments were carried out for larval rearing.



Fertilized eggs of *Sapphire* devil

4th day egg

Biochemical studies on broodstock and larval nutrition

- In order to generate baseline information, muscle and liver of *Cobia* was profiled for fatty acids and amino acids.
- Biochemical analyses of egg of *A. sebae* for fatty acids under green water culture conditions revealed the presence of higher PUFA in the 2 day old eggs (33.87% TFA) as compared to that of 6 day old eggs (8.22% TFA).
- The freshly hatched larvae of *Amphiprion sebae* contained a total of 5.49% polyunsaturated fatty acids, eicosapentaenoic acid being the major component (1.37% TFA) followed by docosahexaenoic (1.37% TFA) and arachidonic acid (0.28% TFA).

Newly hatched larvae

FUNDING AGENCY **Ministry of Earth Sciences**

PROJECT TITLE **Farming and pearl production in the black lip pearl oyster *Pinctada margaritifera* in the Andaman and Nicobar Islands**

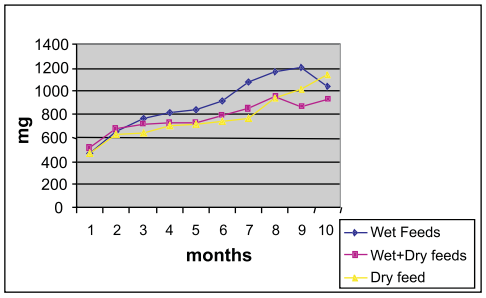
SCIENTISTS **K.S. Mohamed,** T.S. Velayudhan and V. Kripa

CENTRES Port Blair

- Training on Mabe pearl production in *P. margaritifera* and *Pteria penguin* was imparted to 33 shell craft artisans during May 2008 under the auspices of the Gem & Jewellery Export Promotion Council (GJEPC), Southern Region, Chennai and the Small Industries Department of the A&N Islands.
- Although a number of trials conducted earlier using make-shift hatchery facilities did not result in completion of the life cycle, in March, 2009, with the establishment of 1.2 million capacity hatchery, success in spat production was achieved. However, in the first trial survival to spat was poor (<1%). Further trials are planned to improve the survival.

Training on Mabe pearl production

PROJECT CODE	**MBTD/NUT/01**
PROJECT TITLE	**Formulation and evaluation of larval and grow out feed for marine crabs, lobsters, ornamentals and cage farmed finfish**
SCIENTISTS	**P. Vijayagopal,** I. Rajendran, D. Kandasami, Kajal Chakraborty and Margaret Muthu Rathinam
CENTRES	Cochin and Madras



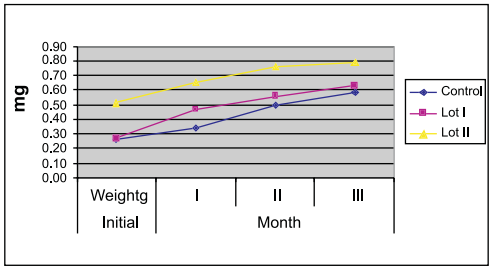
Growth of *Dascyllus aruanus*

Ornamental Fish Nutrition

- Laboratory experiments to evaluate the suitability of wet feeds, formulated feeds, dry and wet feeds in combination revealed positive results. Experimental design consisted of three treatment 1-lesser sardines, non-penaeid shrimp and squid, Treatment 2 – wet feeds and dry formulated feed crumbles in combination and Treatment 3 – dry formulated feed exclusively. Thought wet feeds though showed superiority in terms of growth, the final result of the experiment indicated by spawning (yet to be achieved) will only reveal which of these feed treatments are good for rearing brood fishes in captivity in least time. The influence of these feed treatments on the quantity and quality of the eggs and the young ones produced can be also judged then.
- Amino acid profiles of the whole body of the fish was determined using fish sacrificed and stored at the beginning of the experiment.
- Laboratory experiments conducted at Vizhinjam RC in clown fish (*Amphiprion percula*) to test the long term effect of formulated feed on growth, colour retention and health of these fish showed the usefulness of formulated feed in rearing clown fish. Groups fed with formulated feed showed better growth compared to controls. Even though the results did not indicate statistically significant differences ($P > 0.05$) when analyzed using t-test; fish fed with the formulated feed exhibited good colour retention and better survival than the control group.

Lobster Nutrition

Development of formulated feed for spiny lobster *Panulirus homarus* in high density rearing



Growth of *Amphiprion percula*

- Spiny lobsters were reared at a high density of 25 animals per square meter in 12 m^2 cement tanks. Locally available feed material, sardine meal, fish meal, squid meal and shrimp meal constituted the marine protein mix in the formulation. Sand worm was used as an attractant and growth promoter. The protein level in the diet was approximately 50%. Dry pellets were fed thrice daily in divided doses of 25, 25 and 50% in the morning, noon, and evening for a period of 150 days. Hide outs were provided to restrict cannibalism. The quantity of feed supplied was 3% of the biomass. Initial stocking was at the rate of 1.08 kg/m^2. Initial biomass stocked was 27 kg and the harvested weight was 47 kg. With an FCR of 4, the feed costing about Rs. 60 kg^{-1} is promising as a maintenance cum fattening feed for spiny lobsters.

Bio-growth parameters

Food Conversion Ratio (FCR)	-	4.00
Relative growth rate (RGR)	-	74.01
Specific growth rate (SGR)	-	2.28

FCR – dry weight of feed consumed/ wet weight gain
RGR – percent weight gain over initial weight
SGR – Ln. final weight – Ln. initial weight/ time x 100

- In another experiment of 100 days duration, 12 spiny lobsters were stocked per meter square in a recirculation system. Three different pellet feeds (A - 34 %, B - 41 %, and C - 46 % protein) and live clam (41 % protein) as control feed were tried. The holding tank of 1 ton capacity with black background and 1 m^2 area was used and set on biofilters with the recirculation and screen cover on top. Each tank had a total of 12 animals per square meter (6 males and 6 females.). Ranking of the pellet feed for the lobster was done by giving points. All the points were pooled and tabulated. The highest final survival and net biomass was realized in feed C with high score (232) followed by feed B (182) feed D (170) and feed A (168).
- The harvested lobsters were cooked in brine and organoleptically tested for the quality and flavour of the meat. The result indicates that if not very good, the product was better than the ones grown on clam.

Nutritional Biochemistry

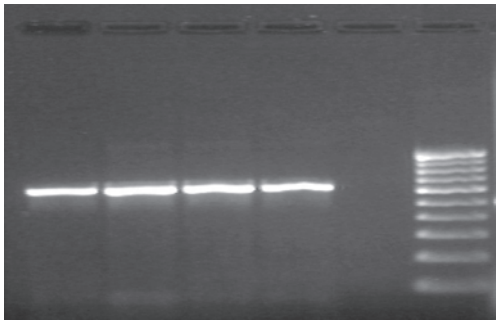
Preparation of polyunsaturated fatty acid (PUFA) concentrates from shark liver oil by physicochemical procedures

- Shark liver oil and ray liver oil (elasmobranchs) were screened for polyunsaturated fatty acids (PUFA's) and essential fatty acids (EFA's. Decosahexaenoic acid (DHA) was higher in shark liver oil (39% of total fatty acid (TFA). Ray liver oil contained only 8.26% DHA. Unlike shark oil, the ray liver oil contains higher monounsaturated fatty acids (MUFAs) (43.27%) and saturated fatty acids (32.9%). PUFA concentrates (58.63% TFA) containing higher docosahexaenoic acid (DHA) content (39.15% TFA) was prepared from shark liver oil by alkaline hydrolysis (pH = 7.6) of triglycerides. DHA has been further concentrated from adipose tissue of shark by means of adsorption and amide complexation, and purified by means of argentated column chromatography to a high purity of >95%.

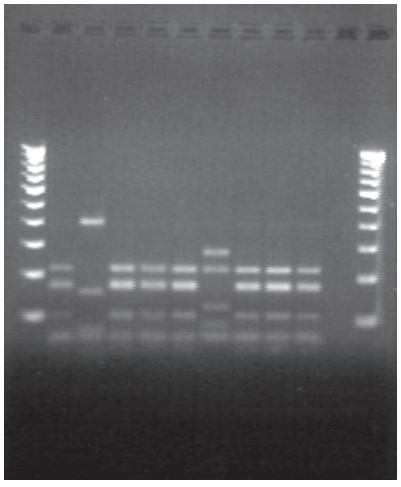
PROJECT CODE	**PNP/BIOT/02**
PROJECT TITLE	**Biotechnological applications in mariculture and conservation**
SCIENTISTS	**P.C. Thomas,** K. K. Vijayan, Srinivasa Raghavan and G. Tamilmani
CENTRES	Cochin and Mandapam

DNA bar-coding of Tunas

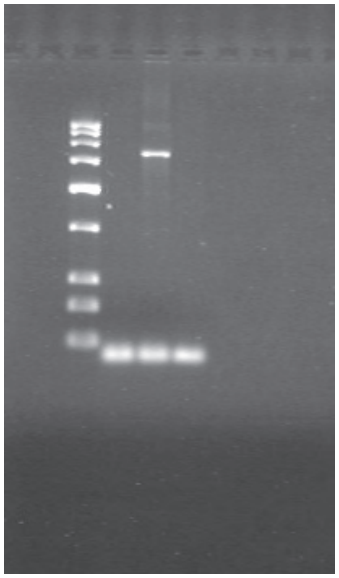
- DNA bar-coding of six commercially important species of tunas namely *Auxis rochei* (Bullet tuna), *Auxis thazard* (Frigate tuna), *Euthynnus affinis* (Little tuna), *Thunnus albacares* (yellow fin tuna), *Katsuwonus pelamis* (Skipjack tuna) and *Gymnosarda unicolor* (Dogtooth tuna) was done to develop molecular taxonomy methods for species identification and also to resolve the species ambiguity using DNA technology.
- Except for one species namely *Gymnosarda unicolor*, all other species had more than 94% similarity at molecular level which confirms species identity. The morphologically identified *Gymnosarda unicolor* species shows similarity with *Thunnus alalunga* species to the extent



Co-1 amplicon of *Auxis rochei*



PCR RFLP of *A. arius* & *A.subrostratus* with Alu1



hsp1 amplicon of *Crassostrea madrasensis*

of 87% at molecular level which would be further confirmed using other genes like Cytochrome b and control regions of mitochondrial genome.

DNA bar-coding in endangered marine catfish:

- DNA bar-coding of *Arius arius, Arius maculatus, Arius subrostratus* was carried out using mitochondrial gene "Cytochrome oxydase subunit 1" (Co1) which form the primary barcode sequence.
- Of the 700 bp segment 557 bp, 545 bp and 323 bp were unambiguous in the three species. The Co1 gene sequence of three catfish species have been deposited with the NCBI gene bank with the following accession numbers

Arius arius	:	FJ 664341
Arius maculatus	:	FJ403390
Arius subrostratus	:	FJ624208

PCR-RFLP of *Co1* gene

- PCR-RFLP of Co1 gene was carried out to develop 'easy to use' species-specific markers for molecular taxonomy and fast identification of the morphologically similar marine catfishes. Species-specific diagnostic RFLP patterns was observed through Restriction analysis with Alu 1.

Cytochrome b profiling

- Characterisation of cytochrome b gene of the three catfish species (*Arius maculatus, A. thallassinus* and *A. subrostratus*) were carried out through PCR amplification using universal primers mcb 398 and mcb 869 followed by sequencing and homology check with other species using BLAST. The sequences were found to have 92% homology with that of other catfish sequences in the database. *A.maculatus* and *A. thallassinus* was to have closer relation than to *Arius subrostratus*.

Molecular genetic characterisation & functional genomics of oysters.

(a) Functional and specific gene profiling

Heat shock protein

- Heat shock protein gene-1 (*hsp-1*) which provide stress tolerance has been identified through PCR amplification of the gene using specific primers. Hsp-1 gene was sequenced, aligned and deposited with NCBI (Gene bank accession number : FJ -707369)

Cathepsin gene

- cDNA of Cathepsin gene involved in disease resistance was generated through RT- PCR of oyster mRNA. This was followed by conventional PCR using the cDNA as template. Quantitative expression of Cathepsin gene using the Real-time PCR for developing selectable disease resistance bio-markers is envisaged to be carried out.

PROJECT CODE	MBTD/PATH/01
PROJECT TITLE	**Pathogen profiling, diagnostics and health management in maricultured finfish and shellfish**
SCIENTISTS	**K. K. Vijayan,** P.C. Thomas, K.S. Mohamed, K.S.Sobhana, Kajal Chakraborty, Boby Ignatius, N.K. Sanil, Rekha Devi Chakraborty, Margaret Muthu Rethinam, Joe K. Kizhakudan, I. Rajendran, G. Tamilmani, M.K. Anil, Saleela K.N and Shubhadeep Ghosh
CENTRES	Cochin, Chennai, Mandapam, Vizhinjam and Veraval

Parasitic infections in Cobia (*Rachycentron canadum*) collected from the Southwest coast of India.

Acanthocephalan (spiny headed worm) infection:

- Infection with the acanthocephalan parasite, *Serrasentis nadakali* was reported from *R. canadum*. The parasite measured more than 10cm in length and resembled a tape worm due to the pseudo segmentation of the body.

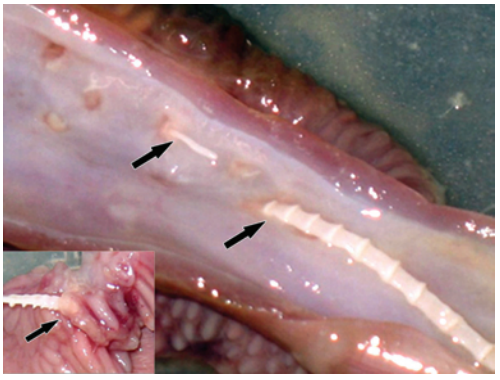
Nematode infection:

- Infection with the nematode parasite, *Philometroides marinus* was recorded from *R. canadum*. Two nematodes were recovered from the same fish and the worms measured more than 80 cm each.
- Both *S. nadakali* and *P. marinus* can affect the health status and thereby the reproductive performance of Cobia broodstock.

S. nadakali attached to the intestine

Protozoan infections in marine ornamental fishes

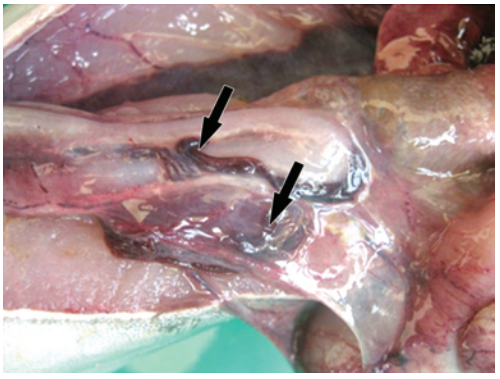
- Myxosporean infections: Parasitic infections were recorded from marine ornamental fishes collected from the Vizhinjam bay area. Two species of myxosporean parasites were recorded from the marine ornamental fish, Sergeant major (*Abudefduf bengalensis*). The parasites were identified as *Ceratomyxa* sp. and *Myxidium* sp.
- Blue damsels (*Pomacentrus caeruleus*), collected from Vizhinjam bay area revealed the presence of a myxosporean parasite in the gall bladder. The parasite was identified as *Zschokkella* sp. and was found infecting the gall bladder. Both plasmodium and mature spores were observed in the swollen gall bladder while the bile appeared dark and viscous.
- *Amyloodinium infestation*: A serious disease condition infecting the gills caused by Amyloodinium was observed in marine ornamental fishes (*Abudefduf bengalensis*) maintained in captive conditions at Vizhinjam. Numerous trophozoite stages were found attached to the surface of the gills. Amyloodinium infestation can cause serious mortalities in marine aquarium species.



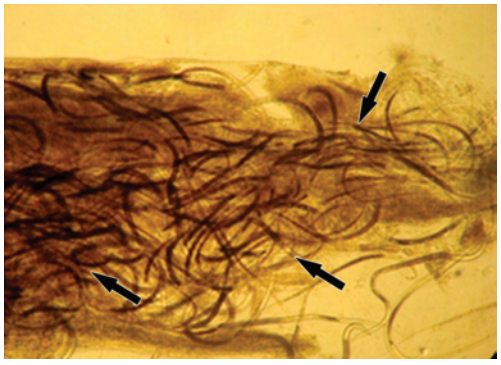
Spines on the proboscis and body

Parasitic infection in pearl oysters:

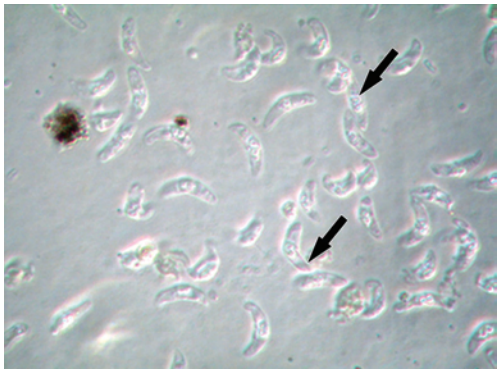
- Pearl oysters (*Pinctada fucata*) collected from both Tuticorin and Vizhinjam were found to be infected with a protozoan parasite, identified as belonging to the genus *Perkinsus*. This is the first report of a *Perkinsus* infection in *P. fucata* from the Indian sub-continent.
- Gills and rectal tissues excised and cultured in Ray's Fluid Thioglycollate Medium for 4-7 days and stained with Lugol's iodine



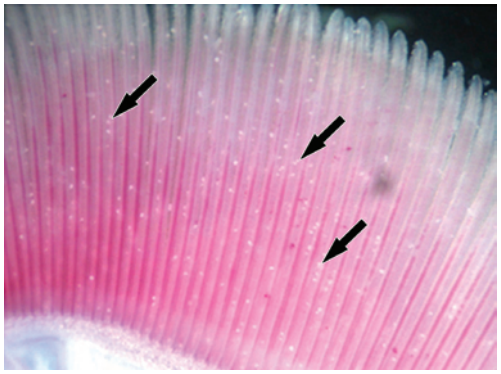
P. marinus on the surface of the intestine



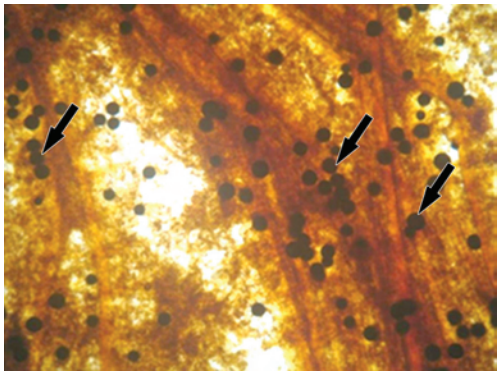
Larvae in the body of the adult worm



A- Spores of *Ceratomyxa* sp.



Trophozoite stages of *Amyloodinium* on the gills



Perkinsus hypnospores in gill tissues

showed large numbers of blue-black hypnospores of *Perkinsus* sp., indicating the presence of Perkinsus infection.

Disease problems in lobsters

Suspected Gaffkemia infections caused by *Aerococcus viridans* reported from impounded lobsters at Vizhinjam

Microbial profiling of lobsters

- Investigation was carried out to study the microbial profile from lobster holding tanks located in the hatchery at CMFRI, Cochin. Water samples from the holding tanks, swabs from the lobsters and swabs from the biofilm were taken twice a month. Gram-positive cultures were identified as *Bacilli* and *Cocci*. Biochemical identification methods from the swab samples were identified as *Staphylococcus* and *Actinomyces*. Confirmation of the identity is being carried out by PCR detection procedures. Oxidase positive isolates were identified as *Aeromonas*, *Pseudomonas* and *Vibrio*. Oxidase negative isolates were identified as *Enterobacteriaceae.*
- Luminescent bacterial disease due to *Vibrio harveyi* was recorded from the larval stages of the sand lobster *Thenus orientalis* at the Kovalam laboratory of CMFRI.

Disease conditions in *Epinephelus malabaricus*

- 'Swim bladder inflation' resulting in the loss of balance and floating at the surface was observed in the broodstock of *Epinephelus malabaricus* at the Mandapam Regional Centre of CMFRI. The specimen was examined for gross pathology, necropsy studies and samples were collected for microbiological as well as histopathology studies. Investigations revealed that the fish had systemic infection by vibrios and severe pathology in the kidney. The *Vibrio* isolates from kidney are being characterized to species level.

Development of fish cell lines

- Five cell culture systems (EM3G Ex; EM2G Ex; EM4Sp Ex; EM2H Tr; EM4HTr) have been developed from the gill, spleen and heart tissues of *E. malabaricus* which are being passaged for developing cell lines.

Bioprospecting marine sources for health management in mariculture

Preparation of enriched EPA concentrates from sardine oil by physicochemical and enzymatic procedures

- A lipase isolated from *Bacillus circulans* originally purified from seaweed *Turbinaria conoides* was able to enrich sardine oil with 37.74 ± 1.98% EPA after 3 h of hydrolysis of triglycerides. The total n-3 PUFA increases with time up to 3 h of lipase-catalyzed hydrolysis (52.71%), beyond which it plateaued down (51.09% at 6 h). Structure-bioactivity relationship analysis revealed that the lower hydrophobic constants of 18:3n3 and 20:5n-3 (log P = 5.65 and 5.85, respectively) results in their higher hydrolytic resistance towards lipase leading to their enrichment in the triglyceride fraction after lipase-catalyzed hydrolysis. Lipase catalyzed hydrolysis of sardine oil for 3 h followed by amide complexation provided free fatty acids containing 76.22% n3 fatty acids with 51.29 ± 4.65% 20:5n-3. The purified methyl ester

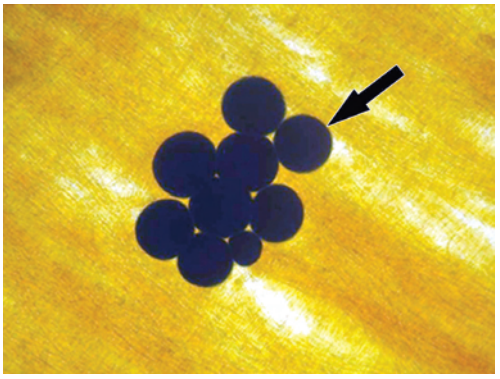
of 20:5n-3 (68.29 ± 2.15%) from the urea concentrate was attained by flash chromatography on argentated neutral alumina. The results suggest that a combination of *Bacillus circulans* lipase-catalyzed hydrolysis followed by urea fractionation and argentated chromatography may be a useful method to concentrate n3 PUFAs from sardine oil.

Development of a nutraceutical from the green mussel *P. viridis*

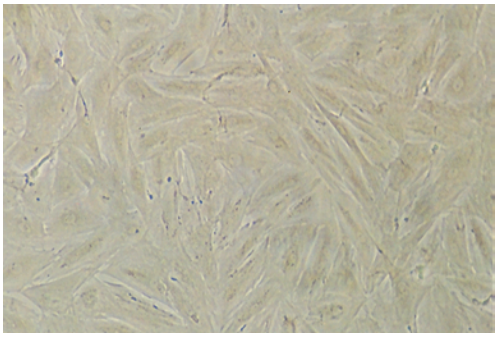
- Green mussel (*Perna viridis*) is useful in the treatment of inflammatory joint diseases. The extract of green mussel collected from Northern and Southern parts of Kerala were examined for nutritional contents.

Nutritional composition of mussels from different parts of Kerala

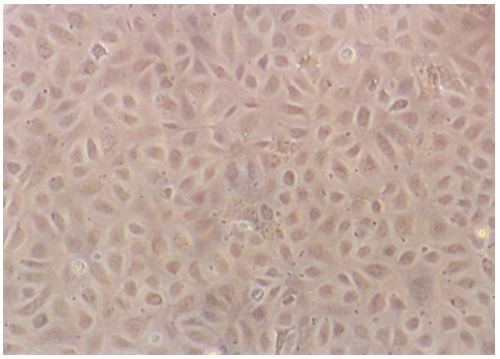
Nutrients	Southern Kerala	Northern Kerala
Proximate (% tissue weight)		
Crude protein	16.85	11.49
Crude fat	2.19	1.62
Crude ash	1.22	1.65
Crude fiber	0.114	0.134
Cholesterol (mg/100g)	**152.09**	**55.48**
Lipid (%)	18.25	24.69
Protein (mg/g)	1.415	1.435
Amino acids (%)		
Aspartic acid	8.03	7.97
Glutamic acid	10.61	9.13
Serine	5.44	5.52
Glycine	11.69	15.47
Histidine	1.78	2.19
Arginine	6.37	3.89
Threonine	5.15	5.37
Valine	4.33	4.63
Methionine	1.75	1.54
Isoleucine	4.08	4.62
Leucine	7.74	6.73
Phenylalanine	3.42	3.96
Lysine	13.04	13.65
Fatty acids (%)		
EPA	10.13	27.24
DHA	9.56	8.89
Total PUFA	35.64	46.04
Monounsaturates	12.66	12.01
Saturates	37.21	29.37
Minerals (ppm)		
Fe	3.080	4.53
Ca	2.410	4.25
Mg	3.037	6.4
Zn	0.118	0.34
Mn	0.089	0.11
Cu	0.06	0.14
Na	95.3	296.15
K	27.91	109.92
Se	0.009	0.022



Perkinsus hypnospores in mantle tissues



EM4H Tr 20p



EM3G (Ex) 73p

Disc diffusion assay of symbiotic bacteria against *V. parahaemolyticus*

Bioprospecting marine macroalgal symbiotic bacteria for antibacterial metabolites

Useful bacteria from seaweeds collected from Gulf of Mannar area of Mandapam

- A number of symbiotic bacteria with antagonistic activity against pathogenic *Vibrios* (*Vibrio parahaemolyticus* ATCC 17802, *V. parahaemolyticus* MTCC 451, and *V. vulnificus* MTCC 1145) have been isolated from red and brown seaweeds from Gulf of Mannar area of Mandapam. The bacteria were identified to be *Bacillus* and *Pseudomonas* sp. *Bacillus alverii* isolated from *Laurencia papilosa* exhibited a zone of inhibition of 30-31 mm against *V. parahaemolyticus* ATCC 17802. Bioassay-guided chromatographic purification of the antibacterial principles from the crude microbial extracts is being carried out.

Bioprospecting antibacterial principles from seaweeds of Gulf of Mannar

- The ethylacetate extract of *Padina gymnospora* extract has been chromatographically purified (103 mg) and evaluated for their potential antimicrobial properties. A linear reduction of bioactivity of the hexane extract is apparent at lower concentration (inhibition zone of 8-9 mm against *V. parahaemolyticus* ATCC 17802 and 9-10 mm against *V. parahaemolyticus* MTCC 451 at 0.1% loading). One of the compounds (F2) separated from the CH_2Cl_2 fraction of *Padina gymnospora* showed higher activity against *V. parahaemolyticus* (inhibition zone of 14-15 mm against *V. parahaemolyticus* ATCC 17809 at 1% loading and 10-11 mm at 0.1% loading). The ethylacetate fraction yielded two components (R_f= 0.48 and 0.71(F11=26 mg and F12=11 mg) after chromatographioc separation. Methanolic and ethylacetate extracts were found to be active (inhibition zone of 11-12 mm against *V. parahaemolyticus* MTCC 451 and *V. alginolyticus* MTCC 4439 cat 0.1% loading). The dichloromethanic extract yielded four major fractions among which the fraction F6 exhibited highest zone of inhibition (11-12 mm against *V. alginolyticus* MTCC 4439 at 0.1% loading). All the extracts are insensitive towards *V. parahaemolyticus* ATCC 17802 and *V. parahaemolyticus* MTCC 451 (a maximum zone of inhibition of 8 mm).

FUNDING AGENCY	**Department of Biotechnology**
PROJECT TITLE	**Development and application of CMG family recombinant hormones, their antagonists and RNAi technique for induced maturation and spawning of *Penaeus monodon***
SCIENTIST	**K.K.Vijayan**
CENTRE	Cochin

Project objective is to develop GIH antagonists as a replacement for the conventional eyestalk ablation technique for the induced maturation of aquacultured *Penaeus monodon* in shrimp hatcheries.

Sequencing and analysis of GIH gene

- Specific primers PmGIH Gene F and GIH R designed based on the only GIH sequence on *P. monodon* available at the Genbank (Acc.No.DQ643389). PCR amplification gave a fragment of size 768 bp from eyestalk cDNA of native female *P. monodon* brood stock. The amplified product was sequenced and the sequence was compared to other available GIH sequences in GenBank and has shown to contain complete coding sequence of the GIH gene.

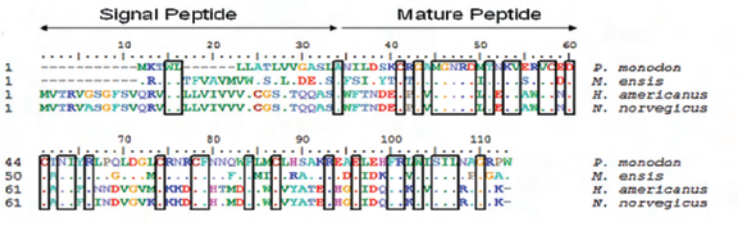
Table 1. Specific Primers for GIH

Primer Name	Sequence
PmGIH Gene F	ATGAAAACATGGCTGCTATTAGCG
GIH R	GGTCGACTTTATTTTAACGGAAAATTAAT
Pm 1.1R	TGGGATGCTTTCAGAGAAGG

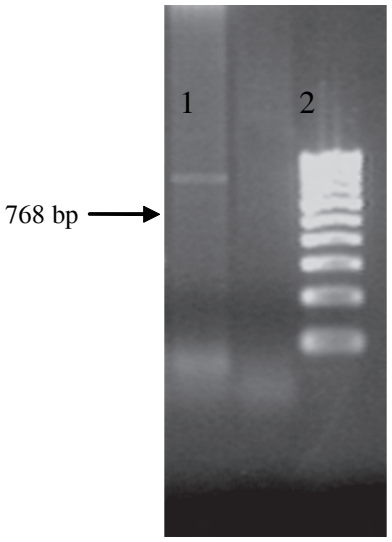
- An internal primer Pm1.1R was designed based on the above sequence information to amplify a shorter fragment with the complete GIH coding sequence. PmGIH Gene F primer along with Pm1.1R primer amplified a shorter fragment of 316 bp in size. The amplified fragment was cloned in PCR TOPO-4 vector and sequenced using vector primers.
- The sequence data obtained were compared with the already available GIH sequences in genbank using the BLAST tool. The analysis showed that it contained the complete Gonad Inhibiting Hormone CDS (Coding Sequence) of 291 bp and is homologues to the GIH sequences of *Metapenaeus ensis (61%), Homarus americanus (41%) and Nephrops norvegicus (43%)*. The deduced amino acid sequence of GIH hormone consists of 96 amino acids that showed the characteristic of type II CMG family neuropeptide and homologues to the GIH sequences reported in GenBank.

Cloning of GIH gene in *Kluyveromyces lactis* Expression vector

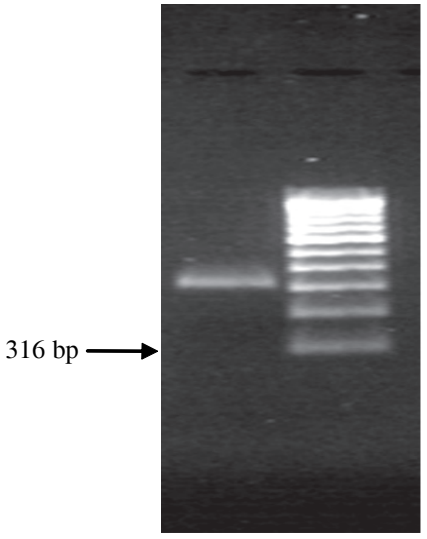
- The GIH CDS obtained is ligated into pKLAC1 vector for transformation into competent *E. coli* cells for multiplication. The recombinant plasmid will be checked for insert orientation by sequencing using vector specific primers, linearised and transformed to *K. lactis* cells for expression.



Comparision of GIH amino acid sequence of *Penaeus monodon with Metapenaeus enesis, Homarus americanus* and *Nephrops norvegicus GIH amino acid sequences.*



Agarose gel with PCR product using Pm GIH GeneF & GIH R primer at lanes 1 and lane 2 is 100 bp DNA marker

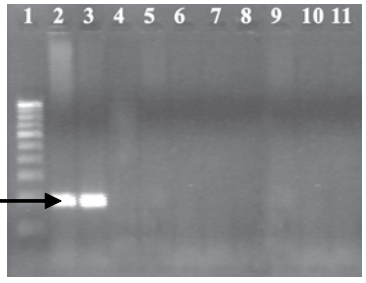


Agarose gel with PCR product using Pm GIH GeneF & Pm1.1R primer at lanes 1 and lane 2 is 100 bp DNA marker

FUNDING AGENCY	**Department of Biotechnology**
PROJECT TITLE	**Development of species specific DNA markers in economically important shellfish species green mussel (*Perna viridis*) and edible oyster (*Crassostrea madrasensis*) for their application in farming and resource management**
SCIENTIST	**K.K.Vijayan**
CENTRE	Cochin

The objective of the project is to develop species specific DNA markers for green mussel *Perna viridis* and edible oyster *Crassostrea madrasensis*, so that identification of these two commercially important bivalves would be possible at the larval stages itself.

- Adult specimens of *Perna viridis* and *Crassostrea madrasensis* were collected based on the distribution and availability from the coastal districts of Kerala. Samples were preserved in 95% ethanol and used



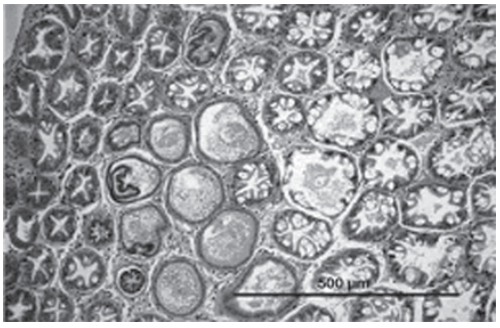
Agarose gel image showing PCR products of the ND4 region

Lane 1 : 100bp marker.
Lane 2 : *P.viridis*
Lane 3 : *P.viridis*
Lane 4 : *P.indica*
Lane 5 : *P.malabarica*
Lane 6 : *Meritrix casta*
Lane 7 : *Saccostrea cucculata*
Lane 8 : *Crassostrea madrasensis*
Lane 9 : *Pinctada fucata*
Lane 10 : *Patella sp.*
Lane 11 : *Parapenaeopsis sp.*

for the extraction of DNA using a standardized phenol-chloroform method (Sambrook *et al.*, 1989).

- Mitochondrial DNA analysis for the gene coding COX-1 (cytochrome Oxidase subunit-I) was conducted using a standard PCR technique with the universal primers (**LCO1490:** GGTCAACAAATCATAAAGATATTGG and **HCO2198:** TAAACTTCAGGGTGACCAAAAAATCA). The PCR products were sequenced and the **9** sequence results were submitted in the database, GenBank of NCBI with the accession numbers starting from **FJ428750** to **FJ428758**.
- Specificity of the species-specific mitochondrial primers of *P. viridis* (**PernaND4Fb**: TGTTCTAGWAATATAGCWGCYCC and **PernaND4Rv:** AATATCTCAT CCCATCATCCTC, reported by Blair *et al.*, 2006) were evaluated with other bivalve species like *Perna indica, Paphia malabarica, Meritrix casta, Saccostrea cucculata, Crassostrea madrasensis, Pinctada fucata, Patella sp.*, and *Parapenaeopsis sp.*, along with *P.viridis* samples. When PCR was conducted using this species specific primers, amplification was obtained only in *P.viridis*, revealing the species specific nature of the primer set, which can be used for the identification of *P.viridis* at molecular level.

FUNDING AGENCY	**ICAR APCess**
PROJECT TITLE	**Investigation on 'Loose shell syndrome' among farmed tiger shrimp, *Penaeus monodon'***
SCIENTIST	**K.K.Vijayan**
CENTRE	Cochin



Hepatopancreatic (HP) tubules undergoing necrosis with sloughing of epithelium and thickening of tubule sheath

- Histopathological investigations on LSS-affected shrimp showed shrinkage of extensor and flexor muscles with occasional hemocytic infiltration. The hepatopancreas showed inflammation of hepatopancreatic tubules with enlargement of intertubular spaces, hemocytic infiltration, and low levels of lipid reserves in the R cells. In advanced stages of LSS, many tubules were in a highly necrotic condition with sloughed epithelium, reflecting the dysfunction of the digestive gland.
- Laboratory challenge studies were carried out using 9 types of inocula prepared from HP and muscle of LSS-affected shrimp and purified fractions obtained by sucrose gradient ultracentrifugation . LSS condition was induced in healthy tiger shrimp by challenge studies using membrane-filtered LSS-affected shrimp tissues, suggesting involvement of a filterable infectious agent. Further studies are required to characterize the filterable infectious agent.

FUNDING AGENCY	**ICAR APCess**
PROJECT TITLE	**Development of gene construct for producing WSSV resistant shrimp and its validation in shrimp cell culture system**
SCIENTIST	**P.C. Thomas**
CENTRE	Cochin

- Primary cell culture system from shrimps *P. monodon* was developed for their transfection with the DNA constructs for white spot syndrome virus resistance. Haemocytes were found to proliferate in M-199 medium with 20% FBS supplement at 28^{0}C with 5% CO_2. Addition of 20-hydroxyzdone was found to result in rapid proliferation in the initial days itself.

FUNDING AGENCY	**Department of Biotechnology**
PROJECT TITLE	**Development of genetically improved strains of Brine shrimp *Artemia* using quantitative and molecular genetic tools**
SCIENTIST	**P.C. Thomas**
CENTRE	Cochin

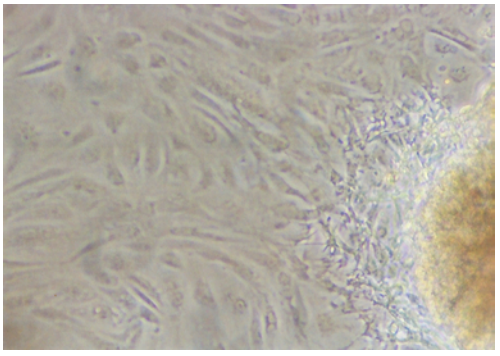
- Indigenously available *Artemia* were collected from different locations along the east and west coasts, maintained and the study of biometrical parameters revealed wide variations which could be exploited through selective breeding.
- Biochemical analysis of the strains for carbohydrate, fatty acids and total proteins in decapsulated cyst, nauplii and adults of each strain were estimated. Quantitative estimation of Polyunsaturated, Monounsaturated and Saturated fatty acids revealed wide strain variations.
- Base generation (So) with broad genetic base was raised and selective breeding was initiated through assortative mating of parents from the base generation for raising the first selected generation and elucidation of quantitative genetic architecture.

FUNDING AGENCY	**Department of Biotechnology**
PROJECT TITLE	**Establishment and characterization of cell lines from selected marine food fish and ornamental fish**
SCIENTIST	**K.S. Sobhana**
CENTRE	Cochin

- Initiated cell culture systems from various tissues of the three spot damsel, *Dascyllus trimaculatus*

Cell culture systems developed from *Dascyllus trimaculatus*

Code No.	Tissue of origin	No. of passages
DT1G Ex	Gill explant	5
DT1F Ex	Fin explant	5
DT1Sp Ex	Spleen explant	Primary culture
DT1H Ex	Heart explant	Primary culture
DT1Cp Ex	Caudal peduncle	2
DT1Cp Tr	Tryspinised caudal peduncle	8



Primary culture from heart explant of *Dascyllus trimaculatus*

FUNDING AGENCY	**Department of Science & Technology**
PROJECT TITLE	**Characterization of novel antioxidant from red and brown seaweeds from Gulf of Mannar**
SCIENTIST	**Kajal Chakraborty**
CENTRE	Cochin

Bioprospecting brown and red seaweeds for potential antioxidant molecules

- Red and Brown seaweeds have been identified in both inter-tidal and deep water regions, which have proven to be rich sources of structurally diverse bioactive compounds with valuable pharmaceutical and biomedical potential. Samples of red and brown seaweeds were collected from exposed intertidal shore in Gulf of Mannar region of Tamil Nadu.

In vitro reactive oxygen species scavenging assay of seaweed extracts

- Development of an optimized procedure for extraction and *in vitro* reactive oxygen species scavenging assay guided chromatographic fractionation of seaweed-derived antioxidant molecules from selected red and brown seaweeds from Gulf of Mannar region of Mandapam have been attempted. The different crude extracts obtained were analyzed using different capacity assays which revealed their antioxidant capacity in hydrogen atom transfer and single electron transfer reactions.

Ethylacetate and dichloromethanic extracts:

- Ethylacetate extract of *Sargassam longifolium* exhibited highest DPPH free radical inhibition (87.00 ± 0.32%) followed by *Hypnea musciformis* (83.56 ± 1.03%). The radical scavenging activities of EtOAc extracts of *Gracilaria acerosa* (0.80 ± 0.02%) and *Turbinaria conoides* (0.82 ± 0.04%) were found to be comparable with respect to their reducing capacity. Dichloromethanic extract of *S. longifolium* exhibited significant DPPH radical scavenging activity (80.30 ± 1.33%) and total phenolic content (78.63 ± 6.30%).
- Ethylacetate and dichloromethane extracts were found to be potential sources of antioxidant principles, which are being chromatographically purified to isolate the bioactive molecules.

Hexanic and methanolic extracts:

- Hexanic extracts of the seaweeds exhibited comparatively lower activity independent of different assay conditions. However, the hexanic extract of *S. plagiophyllum* recorded higher DPPH radical scavenging activity (38.06 ± 2.96%). The hexanic extract of *H. musciformis* (27.85 ± 2.48%) showed highest phenolic content, whereas *S. marginatum* (0.55 ± 0.02%) and *S. longifolium* (8.86 ± 0.14%), recorded highest reducing and H_2O_2 scavenging capacities respectively.
- Methanolic extract of *S. longifolium* exhibited a marginal DPPH radical scavenging (33.86 ± 1.26%), and no significant activities were apparent in methanolic extracts of other species. No visible H_2O_2 scavenging capacity and the total phenolic content of other species of seaweeds were recorded and therefore, the methanolic extract may not be a potential source of antioxidant molecules.
- EtOAc fraction of *Acanthophora specifera* was chromatographed to give off white solid (27 mg). The fraction F_6 of the CH_2Cl_2 extract of *A. specifera* was recrystallised in CH_3CN to furnish two compounds, one being a white (13 mg) and the other a brown solid (32 mg). EtOAc fraction from *Laurentia papillosa* was purified over silica gel to furnish two major compounds S_1 (yellow oil) and S_3 (brownish oil). Different solvent fractions of *S. longifolium* were fractionated in step solvent gradients to yield fractions.
- CH_2Cl_2 extract of *T. ornata* yielded a dark brown residue that was recrystallised in Me_2O to yield a white crystalline solid (200 mg).
- EtOAc extract of *Padina gymnospora* were purified to yield a white crystalline material (38 mg) and a brownish yellow solid (50 mg). Other crude extracts are being purified to isolate the compounds

responsible for antioxidant activity. The purified compounds are being assayed for antioxidant capacities.

Spectroscopic identification of purified molecules from seaweeds

- The major compounds are being identified on the basis of their ^{1}H NMR and ^{13}C NMR spectra, including 2D NMR, as well as their mass and fourier-transform infrared spectra. The information will help in generating a database of antioxidant molecules from widely available red and brown seaweeds in Gulf of Mannar waters for application in formulated feeds for aquaculture and allied areas.

FUNDING AGENCY	**ICAR Outreach Programme**
PROJECT TITLE	**Nutrient profiling evaluation of fish as a dietary component**
SCIENTIST	**Kajal Chakraborty**
CENTRE	Cochin

Survey:

- Detailed filled-up survey questionnaires have been received for Allapuzzha, Nayarambalam, Chellanam, and Narakkal villages of Kerala. The surveys have been conducted for 500 each of fishing and non-fishing population in each site.

Nutritional composition analyses for candidate fish species collected in different seasons and different locations (eastern and Western coast of India):

- Different genera of fishes (*Lepturacanthus savala*, *Katsuwonus pelamis*, *Leiognathus splendens*, and *Sardinella longiceps*) have been collected along with maricultured and wild *Crassostrea madrasensis* and *Perna* sp during different months and locations to understand the influence of spatial and temporal variation on the nutritional components of candidate fish species, to underline the candidate marine fish species with high nutritional qualities.

Edible oyster- *Crassostrea madrasensis*

Fatty acid composition of the candidate finfish and bivalve mollusks

Mussel (*Perna* sp.)

- DHA and EPA were found to be 7.63% and 8.08% in mussels collected from southern Kerala. EPA was recorded to be more (27.24%) in green mussels collected from northern Kerala. Similarly DHA was found to be significantly higher (8.89%) in green mussel from northern Kerala. *P.indica* was found to contain higher saturated fatty acides (16:0 being predominant) thus proving the superiority of brown mussel from northern Kerala as health food.
- **Oil sardine (*Sardinella longiceps*):** Among PUFAs, EPA was the dominant one (13.8%) followed by DHA (5.1%), 18:2n6 (2.8%), and 20:4n6 (0.9%). However, the species collected during November exhibited a higher content of as revealed from the higher percentage of 20:4n6 (2.28%), DHA (7.28%) and EPA (16.69%), PUFAs.
- **Silverbelly** (*Leiognathus splendens*)**:** Silverbellies collected during winter season (November) recorded a higher content of 20:5n3 (9.66%) than samples collected in September (7.6%).
- **Ribbonfish** (*Lepturacanthus savala*) **and skipjack tuna** (*Katsuwonus pelamis*)**:** Recorded very high content of long chain

PUFA particularly DHA (12.11 and 19.30%, respectively). The total PUFA in these two genera were recorded as 23.9 % in ribbonfishes and 32.06% in skipjack tuna.

- **Edible oysters** (*Crassostrea madrasensis*)**:** A marginal increase in the content of DHA (8.34%) was apparent in the wild samples of *Crassostrea madrasensis* obtained in November than those obtained in September (8.16%). DHA and EPA were found to be 8.16% and 17.25%, respectively in the wild *Crassostrea madrasensis*.
- ***Minerals:*** Mg was found to be more in fish samples from south eastern region (Mandapam), than from southwestern. *S. longiceps* and *L. savala* collected from southwestern region recorded more Na than others. *L. splendens* from Mandapam and *S. longiceps* from Kerala had more K. *K. pelamis* collected from Mandapam had more Se (0.148 mg/L). Samples from southeastern region had higher Se than from southwestern coast. *S. longiceps* recorded to contain more Mn than other species.

Differential composition of amino acids of candidate finfish and bivalve molluscs collected from Kerala

Species	Amino acids (%)												
	Asp	Glu	His	Arg	Thr	Tyr	Val	Met	Cys	Ile	Leu	Phe	Lys
S. longiceps	7.04	9.67	2	4.82	5.24	2.54	4.87	2.41	0.28	3.97	7.89	3.64	13.13
E. malabaricus	7.14	10.27	2.25	5.05	5.03	3.01	4.72	2.66	0.49	4.14	8.15	3.64	15.11
L.splendens	6.67	10.59	1.65	5.38	4.69	2.38	5.44	2.11	0.38	4.4	8.74	3.69	14.31
C. madrasensis	6.81	8.64	1.73	6.05	5.21	2.97	4.62	2.25	0.54	4.04	7.5	3.91	12.12
L. savala	6.18	10.34	1.9	4.22	5.76	3.08	4.77	3.00	0.4	4.4	8.41	4.24	13.56

- ***Lipid and cholesterol:*** *K. pelamis* and *P. viridis* collected from Southwestern region of India recorded more cholesterol.

Fish species	Nutrients (mg/g)
southwestern region (Kerala)	**Cholesterol and protein***
S. longiceps	30.64 (86.70)
L. splendens	73.56 (11.53)
L. savala	43.68 (8.05)
E. malabaricus	63.85 (20.37)
C. madrasensis	45.57 (58.72)
K. pelamis	168.93 (10.24)
P. viridis (South Kerala)	152.09 (1.42)
P. viridis (North Kerala)	55.48 (1.44)
Southeastern region (Mandapam)	
L. savala	48.98
E. malabaricus	15.99
L. splendens	20.51
S. longiceps	20.51

* The protein values are indicated in parentheses.

Proximate composition of candidate finfish collected from southwestern zone of India (Kerala)

- ***Sardinella longiceps:*** *S. longiceps* collected during January was found to contain higher protein (16.71%) as compared to the samples collected during November-December. The fat content of *S. longiceps* collected in January was recorded to be lower than those collected during November apparently due to their smaller size.

- ***Epinephelus malabaricus* and *K. pelamis*:** *E. malabaricus* contained 18.63% crude protein and 1.08% minerals, whereas *K. pelamis* recorded the values as 25% and 1.27% respectively.
- ***Lepturacanthus savala* and *Leiognathus splendens*:** These species recorded 18.33% and 12.09% crude protein respectively. The crude fat content of the latter was found to be significantly higher (17.1%) than the former (3.63%) due to the larger size of *L. savala.*

Proximate composition of finfish and bivalve molluscs

Region and Month	Species	Proximate composition parameters (% wet tissue weight)			
Kerala (southwestern)	**Crude protein**	**Crude fat**	**Crude ash**	**Crude fiber**	
September 2008	*Crassostrea madrasensis* wild	8.86 ± 0.13	1.52 ± 0.01	1.61 ± 0.00	0.07 ± 0.01
	C. madrasensis cultured	8.53 ± 0.04	3.53 ± 0.01	1.53 ± 0.04	0.05 ± 0.02
	Perna viridis wild	16.85 ± 0.02	2.19 ± 0.08	1.22 ± 0.00	0.11 ± 0.02
	P. viridis cultured	12.63 ± 0.17	2.48 ± 0.04	0.93 ± 0.03	0.08 ± 0.01
	P. indica wild	14.26 ± 0.01	5.12 ± 0.23	0.93 ± 0.00	0.14 ± 0.00
November 2008	*Lepturacanthus savala*	18.33 ± 0.01	3.63 ± 0.01	1.23 ± 0.00	0.18 ± 0.02
	Katsuwonus pelamis	25.00 ± 0.09	0.22± 0.01	1.27 ± 0.01	0.24 ± 0.01
	Epinephalus malabaricus	18.63 ± 0.49	1.38 ± 0.01	1.08 ± 0.00	0.21 ± 0.01
	Leiognathus splendens	12.09 ± 0.06	17.11 ± 0.00	2.39 ± 0.04	0.34 ± 0.02
	C. madrasensis cultured	7.48 ± 0.086	1.52 ± 0.01	1.61 ± 0.00	0.07 ± 0.01
	P. viridis wild*	11.49 ± 0.02	1.62 ± 0.00	1.65 ± 0.01	0.13 ± 0.00
January 2009	*Sardinella longiceps*	16.71± 0.01	1.62± 0.00	2.96± 0.03	0.06± 0.00
March 2009	*P. viridis* wild*	13.17 ± 0.02	1.96 ± 0.02	1.65 ± 0.03	0.08 ± 0.01
Mandapam (southeastern)					
January 2009	*L. savala*	17.28 ± 0.11	15.28 ± 0.00	1.39 ± 0.03	0.195 ± 0.00
	E. malabaricus	18.07± 0.00	1.27 ± 0.06	1.14 ± 0.04	0.07± 0.02
	L. splendens	16.96 ± 0.01	2.10 ± 0.05	2.98 ± 0.06	0.06 ± 0.01
	S. longiceps	16.79 ± 0.09	0.73 ± 0.00	3.05 ± 0.01	0.13± 0.04

* *Perna viridis* collected from Northern Kerala (Calicut). Rests were collected from Cochin and Alleppey. The results are expressed on wet tissue basis

FUNDING AGENCY	**ICAR Outreach Programme**
PROJECT TITLE	**Fish Feeds**
SCIENTIST	**P.Vijayagopal**
CENTRE	Cochin

Under the outreach project, the first objective is to develop an enrichment product for marine finfish larviculture.

Incorporation of essential fatty acids by the rotifer *Brachionus plicatilis* fed with *Nannochloropsis occulata* and Algamac-2000

- As a beginning, rotifers were enriched with *N. occulata* and Algamac – 2000 (spray-dried cells of *Schizochytrium* sp.) and the fatty acids were profiled to estimate the level of enrichment.

Fatty acid composition of control rotifers and rotifers enriched with microalgae

Fatty acids	*N. occulata*	Control rotifer (% total fatty acids)	Rotifer enriched (3h)	Rotifer enriched (6 h)
14:0	5.19	5.00	6.18	6.72
16:0	21.59	29.85	26.60	28.3
18:0	10.83	3.63	2.94	4.06

Total SFA	37.61	38.48	35.72	39.08
16:1n7	16.88	13.07	14.71	18.9
18:1n9	19.50	21.54	17.52	18.8
24:1	1.23	1.49	1.28	1.72
Total MUFA	37.61	36.1	33.51	39.42
Cis-18:2n6	1.52	19.50	22.64	17.21
18:3n3	0.67	1.32	0.13	0.15
C_{20}:2n6	2.05	0.91	1.35	1.04
C_{20}:3n6	0.79	0.33	0.21	0.15
C_{20}:4n6	2.15	0.58	1.30	0.96
20:5n3	9.72	0.21	3.65	0.06
22:6n3	1.69	0.05	0.60	0.15
Total PUFA	18.59	22.9	29.88	19.72

- The results were compared with algal replacement product (Algamac 2000) and spray dried *Schizochytrium* sp. Analysis of Algamac 2000 for essential fatty acid profiles showed that the abundance of the fatty acid content of the product was 16:0> 22:6 n-3 >18:0 >20:5n3 > 20:3 n-6> 16:1n-7, in decreasing order. Among SFAs, 16:0 was found to be the most dominant contributing 40.94% of TFAs. Among n-3 fatty acids, DHA was found to be the most abundant (20.11% TFA). The C_{18} fatty acids were present in small amounts in Algamac 2000 (17.54% TFA), although significantly higher content of C_{16} PUFAs (40.94% TFA) were apparent.
- Rotifers were enriched with Algamac 2000 for 0-6 hours and samples were collected for three durations (1 h, 3 h, and 6 h). The rotifers enriched with Algamac-2000 for 3 h exhibited 22:6 n-3 and 20:5 n-3 as 2.36% and 0.51% total fatty acids, respectively. However, after 6 h the essential n-3 fatty acids exhibited a reduced content. Therefore, it can be deduced that 3 h enrichment is better than 6 h enrichment of rotifers both for *N. occulata* and Algamac-2000.
- Rotifers cultured with Algamac-2000 for 6 h do not exhibit further increased concentrations of DHA (0.13%) in their fatty acids. Estriol (R_t 10.06) and α-estradiol (R_t 8.65) were found to be the major components of the rotifers enriched with the algae, and no α-isomer of estradiol was present. However, after prolonged enrichment, the content of β- analogue of estradiol was found to be reduced apparently due to the catabolic breakdown. Unenriched rotifers were found to contain the β-isomer of estradiol, and therefore the 17α- analogue of estradiol present in the enriched rotifer was obtained from the dietary source (alga) or the isomeric conversion has taken place due to the isomerase.

Fractionation of seerfish roe (*Scomberomorus guttatus*) for phospholipids and triglycerides to be used as feed supplements in aquaculture nutrition

- Seer fish (*Scomberomorus guttatus*) roe is cheaply available in the market (Rs. 80/- kg^{-1}) and can be exploited for concentrating fatty acids and as a source of feed supplements in aquaculture nutrition. It was observed that the phospholipid fraction contain considerable DHA (24.28%) and ARA (5.15%) as major PUFAs followed by EPA (5.15%). On the other hand the saturated fatty acids are seen to be more (36%) in the triglyceride fraction than in phospholipids (33%). Imminently, seer fish roe phospholipids can be used as an aquafeed supplement for improvement of larval survival.

Technology Assessed & Transferred

CMFRI has initiated a major programme on cage aquaculture of finfishes with the support of NFDB, an agency which is promoting cage aquaculture. NFDB sanctioned 14 open sea floating cages for open sea cage culture demonstration farms across the country along almost all the maritime states in India to increase fish production and thereby providing an avenue for the fishers to augment their present income level. Under this project cages as well as nets were fabricated in all the 14 identified centres. All the 14 cages were moored in the sea and 10 were stocked with fishes and cultures are progressing with the association of fishermen co-operative societies/ fishermen self help groups.

The details of locations where the cage culture being undertaken are as follows.

Centre	No. of Cages	The item of fish to be cultured
Mumbai	2	1 Fish, 1 Lobster
Nellore	2	1 Fish, 1 Shrimp
Pulicat	2	1 Fish, 1 Lobster
Mangalore	2	1 Fish, 1 Shrimp
Kochi	2	1 Fish, 1 Shrimp
Balasore	1	1 Fish
Srikakulam	1	1 Fish
Kakinada	1	1 Shrimp
Veraval	1	1 Lobster
Vizhinjam	2	1 Lobster, 1 Fish

Two cages were moored in the sea off Munambam, about 5 kms away from the shore, at 10 mts depth and one was stocked with finger lings of seabass (4 – 6 cms in length and 2 – 6 gm in weight) on 17th December 2008 and another with juveniles of shrimps, *P. indicus* on 3rd January 2009.

Launching of Cage at Munambam, Kochi

Special Infrastructure Development

Dr.Mangala Rai inaugurating the Marine Hatchery Complex at Mandapam

'Lakshadweep Shelf'- a showcase at the Marine Biodiversity Museum

Inauguration of Marine Hatchery Complex at Mandapam Regional centre of CMFRI

- The marine hatchery complex in the Mandapam Regional Centre of CMFRI was inaugurated by Dr.Mangala Rai, Secretary, DARE & Director General, ICAR on 09.01.2009. The function was presided over by Dr. S. Ayyappan, Deputy Director General (Fisheries), ICAR. Prof.(Dr.) Mohan Joseph Modayil, Member, Agricultural Scientists Recruitment Board, New Delhi was the guest of honour in the function. The new pamphlet on the Mandapam Regional Centre of CMFRI highlighting the research activities also was released in the function.

Inauguration of new wet hatchery at Kochi

- The Director CMFRI inaugurated new wet hatchery at Kochi along with the renovated museum and renovated library on 29.12.2008.

'Lakshadweep Shelf'- an exclusive showcase at the Marine Biodiversity Museum

- A 'Lakshadweep Shelf', dedicated solely to some of the valuable collections including molluscan shells, corals and models of crafts from the Lakshadweep Archipelago has been established in the Marine Biodiversity Museum at CMFRI Headquarters. These collections of beauty and splendour exhibited in the exclusive showcase have been presented by Shri B.V. Selvaraj, IAS, Hon'ble Administrator of the UT of Lakshadweep, who in one of his visits to CMFRI was highly impressed by the array of display in the Museum.

Inauguration of the Farmer's Guest House at CMFRI, Cochin

- The Guest House was inaugurated by Dr. S. Ayyappan, Deputy Director General (Fisheries). It is located in the campus of CMFRI, Cochin.
- Installation of new 400 KV Transformer and DG Set at Kochi.
- Rain water harvesting system at Mandapam.
- Acquisition of 50 cents of land at Mangalore.

Human Resource Development

Ph.D

Ms Anjana Mohan, was awarded Ph.D degree by the Cochin University of Science and Technology for her thesis entitled "Eco-biology and Fisheries of the whelk *Babylonia spirata* (Linnaeus, 1758) and *Babylonia zeylanica* (Bruguiera, 1789) along Kerala coast, India. The work was done under the research guidance of Dr.V.Kripa, Principal Scientist, Tuticorin Research Centre of CMFRI.

S.Lakshmi Pillai, Scientist (SS) was awarded Ph.D degree by the University of Calicut for her thesis entitled "Reproductive biology of the Indian spiny lobster *Panulirus homarus.*

Smt.Geetha Sasikumar, Scientist, Sr. Scale, MFD was awarded Ph.D. Degree by the Department of Bio-Sciences, Mangalore University for her research study on "Studies on the Coastal Water Quality in relation to the Health of Green Mussel *Perna viridis* (Linnaeus).

Shri Sujit Sundaram, Technical Assistant (T-3), was awarded Ph.D. by Mumbai University on 19th September, 2008. The thesis titled " Biology of *Sepiella inermis* in Mumbai waters" was carried out under the guidance of Dr. M. Z. Khan, Rtd. Principal Scientist.

Training Programmes

Location	Course	Participants		Agency
		Men	Women	
Kottathurithy, Badagara 04-02-08	Mussel culture	5	20	MPEDA, Kannur & CMFRI, Kozhikode
State Fisheries Department, Kozhikode. 27-02-08	Mussel culture	28	45	BFFDA & CMFRI, Kozhikode
Vallikunnu, Malappuram 03-03-08	Mussel culture	34	31	BFFDA & CMFRI, Kozhikode
KVK, Njarakkal 10-04-08	Bivalve depuration	7	21	ADAK Ernakulam
KVK, Njarakkal 11-04-08	Bivalve depuration	24	136	ADAK Ernakulam
CMFRI, Kochi	Mussel &Edible	TN State Fisheries Officials		
14/15-05-08	Oyster farming	18	2	MFD & HRD Cell, CMFRI, Kochi
MFDPort Blair 07-05-08	Mabe pearl production in blacklip pearl oyster	27	6	Gem and Jewellary Export Promotion Council (GJEPC)
MFD, Kochi 24-05-08	"Mabe" pearl production	3	2	MFD, CMFRI, Kochi
MFD, Kochi 05-07-08	Bivalve taxonomy & identification	14	3	MFD, CMFRI, Kochi
MFD, Kochi 15-07-08	All aspects of Molluscan culture, capture and species identification	1		HRD Cell, CMFRI, Kochi
CMFRI, Kochi 16-07-08	Biology of commercially important molluscs (Squids & cuttlefish)	4	15	HRD Cell, CMFRI, Kochi
CMFRI, Kochi 29-07-08	Biology of commercially important molluscs(Squids & cuttlefish)	21	1	HRD Cell, CMFRI, Kochi
Moothakunnam 29-01-09	Mussel & Oyster farming Officials, entrepreneurs and farmers from Goa.	20	2	MFD, Kochi
Kollam 17/18-03-09	Mabe" implantation		3	BFFDA,Kollam

Krishi Vigyan Kendra

Dr.G. Syda Rao, Director, CMFRI inaugurating Awareness programme

As per the mandatory objectives, the Krishi Vigyan Kendra has organized training programmes for different categories of beneficiaries, front line demonstration programmes, On-farm testing programmes and other extension activities during the year under report, aimed at promoting area development, employment generation, and increasing production in agricultural and allied sectors through technology assessment / refinement / upgradation and popularization

Training programmes

Discipline-wise details of training courses conducted

Discipline	Number of Courses	Participants		
		Male	Female	Total
Fisheries	10	170	136	306
Agriculture	28	396	270	666
Home Science	19	86	320	406
TOTAL	57	652	726	1378

Discipline-wise details of training courses conducted
a. Practicing farmers (On-campus)

Discipline	Course Title	No. of courses	Number of participants			
			Male	Female	Total	SC
Fisheries	Mushroom spawn production	2	29	34	63	6
	Coconut cultivation	1	18	7	25	8
	Coconut nursery preparation	1	11	6	17	5
	Coconut planting methods	1	14	7	21	3
	Integrat. nutr. mngmt. in coconut	1	15	7	22	6
Agriculture	Nutr.deficiency syndrome in coconut	1	15	7	22	9
	Mngmt. of major pests in coconut	1	10	8	18	7
	Integrated rodent control in coconut	1	17	12	29	6
	Bud rot management in coconut	1	11	10	21	6
	Integrat. root wilt mngmt.in coconut	1	16	11	27	8
	Total	11	156	109	265	64
Home Science	Diversified value added fish products	1	0	20	20	0
	Total (a)	**12**	**156**	**129**	**285**	**64**

b. Practicing farmers (Off-campus)

Discipline	Course Title	No. of courses	Number of participants			
			Male	Female	Total	SC
Fisheries	Ornamental fish culture	1	27	13	40	7
	Cage culture of mud crab	1	33	1	34	12
	Total	**2**	**60**	**14**	**74**	**19**
AGRICULTURE	Integrat.pest mngmt.in banana	2	30	5	35	6
	Integrat.pest mngmt.in jasmine	1	6	4	10	0
	Pokkali paddy cultivation	1	6	0	6	0
	Rural godown schemes	1	30	5	35	1
	Scaling up of water productivity in agricult.	1	40	10	50	3
	Disease management in banana	1	16	7	23	8
	Scientific mngmt. of coconut farm	1	9	12	21	0
	Vegetable cultivation	1	7	17	24	21
	Management of leaf spot in banana	1	13	4	17	3
	Mngmt. of pseudostem weevil in banana	2	26	10	36	8
	Integr. nutr. mngmt. in banana	1	18	11	29	6
	Total	**13**	**201**	**85**	**286**	**56**
Home Science	Value addition of fish & shrimp	1	1	14	15	0
	Detergent soap making	1	0	20	20	0
	Value addition of shrimp	1	7	14	21	21
	Total	3	8	48	56	21
	Total (b)	**18**	**269**	**147**	**416**	**96**

c. Rural Youth (On-campus)

Discipline	Course Title	No. of courses	Number of participants			
			Male	Female	Total	SC
Fisheries						
Agriculture	Mushroom spawn production	1	22	23	45	5
Home Science	Value addition of fish and shrimp	2	8	27	35	4
	Value addition of aquaculture products	1	0	20	20	19
	Total	3	8	47	55	23
	Total ©	**4**	**30**	**70**	**100**	**28**

d. Rural Youth (Off-campus)

Discipline	Course Title	No. of courses conducted	Number of participants			
			Male	Female	Total	SC
Fisheries	Ornamental fish culture	3	61	25	86	28
	Brackish water fish farming	1	18	20	38	0
	Total	**4**	**79**	**45**	**124**	**28**
Agriculture	Mushroom cultivation	1	6	13	19	1
	Vegetable cultivation	1	0	33	33	7
	Total	**2**	**6**	**46**	**52**	**8**
Home Science	Fruit preservation	1	6	14	20	0
	Mussel pickle preparation	1	6	14	20	0
	Diversified value added fish products	1	0	25	25	0
	Value addition of fruits	3	10	80	90	0
	Household cleaning materials	1	2	18	20	20
	Home care products	1	0	20	20	0
	Value addition of shrimp	1	20	0	20	0
	Value addition of mushroom	1	12	13	25	2
	Total	**10**	**56**	**184**	**240**	**22**
	Total (d)	**16**	**141**	**275**	**416**	**58**

e. Extension personnel (On-campus)

Discipline	Course Title	No. of courses	Number of participants			
			Male	Female	Total	SC
Fisheries	Coastal aquaculture	3	22	56	78	3
Home Science	Diversified value added fish products	1	0	2	2	0
	Value addition of Shrimp	1	14	19	33	0
	Total	**2**	**14**	**21**	**35**	**0**
	Total (e)	**5**	**36**	**77**	**113**	**3**

f. Extension personnel (Off-campus)

Discipline	Course Title	No. of courses	Number of participants			
			Male	Female	Total	SC
Fisheries	Coastal aquaculture	1	9	21	30	2
Agriculture	Integrated pest management in Paddy	1	11	7	18	0
	Total (f)	**2**	**20**	**28**	**48**	**2**
	Total of (a)+(b)+(c)+(d)+(e)+(f)	**57**	**652**	**726**	**1378**	**251**

Concluding session of Farmers' Field School

Sponsored Training Programmes

Farmer awareness programme on Rural Godown Schemes

The KVK and the Directorate of Marketing and Inspection (DMI), under the Ministry of Agriculture, Govt. of India, Regional Office,Kochi jointly organized a three days Farmer Awareness Programme on 'Rural Godown Schemes' during 14-16 October 2008 at CMFRI Headquarters premises,Cochin,funded by the latter.

Farmers' Field School

Three programmes of Farmers' Field School were organized: two on 'Integrated Pest Management in Banana' at Mookannur and Ezhikkara Village and one on 'Integrated Pest Management in Coconut' in Narakkal Village. Altogether 66 farmers and 4 Agricultural Extension Officers were benefited by the programme on IPM in Banana and 33 farmers and 2 AEOs by IPM in Coconut

Front Line Demonstration [FLD] & On Farm Testing [OFT]

Discipline	Programmes	
	Activities under FLD	Activities under OFT
Fisheries		i.. Culture of alternative species of crab ii. Cage culture of Sea Bass in polyculture system
Agriculture	i. Cultivation of Pokkali paddy variety,VTL-6 ii. Cultivation of Krishnashree Amaranthus iii. Cultivation of Cassava variety,Sreejaya	i. Cultivation of Pokkali paddy variety,VTL-7 ii. High density planting of Banana iii. Coconut climbing Machines
Home Science		Hygienic meat (Bivalve) production

Science camp

A Science Camp on Coastal Aquaculture for 27 students and 3 staff of Govt.Vocational (Aquaculture) Higher Secondary School, Narakkal was organized during 29/11/2008 – 11/12/08 at CMFRI headquarters, Cochin.

Radio/ Television/ News Paper coverage of programmes : 13

Programmes under Kerala State planning Board funding

The KVK has also undertaken On Farm Testing of the New Pokkali Paddy variety, Vyttila-7,in 0.85 ha in Kumbalam Village and Front Line Demonstration of the cultivation of another Pokkali variety, Vyttila-6 in 5 Units of 1 ha each in Kadamakkudy village in Ernakulam District during the year funded by Kerala State Planning Board

Front Line Demonstration of Pokkali Paddy cultivation

Human Resources Development programmes

The staff of KVK have undergone the following training programmes

Name of staff	Title of training	Dates & Duration	Organizing Agency
Dr.K.Asokakumaran Unnithan	Portable carp Hatchery: its installation and operation	11/3/2009 to 13/3/09 (3 days)	Central Institute of Freshwater Aquaculture, Bhubaneswar
Shri.J.Narayanaswamy	Team building and Goal setting, for Teachers of KVK	17/2/2009 to 21/2/09 (5 days)	Kerala Agricultural University,Thrissur
Shri.J.Narayanaswamy	Commodity Futures	27/3/2009	-do-
Shri.M.P.Sivadasan	-do-	-do-	-do-
Shri.M.M.Bhaskaran	Technology Assessment, Refinement and Demonstration	25/2/2009 to 28/2/09 (4 days)	Central Plantation Crops Research Institute, Kasaragod

Awards & Recognitions

Dr. G. Syda Rao receiving the Rajashri Tandon award

- CMFRI won the Rajashri Tandon Award for the year 2008.
- V.V. Singh was awarded with first prize for best Hindi article presentation "*Tatiya Mekhala Prabandahn Hetu Tatiya Paryavaran ki Nirantar Janch ki Avashyakta tatha Mahatwa*" in National Official Language Seminar on Coastal Zone Management on 30th May at Central Marine Fisheries Research Institute, Kochi.
- Smt. Bindu Sulochanan won the Best paper presentation award in the National Official Language seminar on Coastal Zone Management conducted by CMFRI, Kochi on 30 May 2008.
- Kajal Chakraborty won the Pran Vohra Award of Indian Science Congress Association for the year 2007-2008.
- Kajal Chakraborty won Profs. T.J. Pandian and A.J. Matty award 2008 from Indian Fisheries Society.
- Dr.(Mrs). Josileen Jose was selected for the Department of Biotechnology Overseas Award for the year (2007-08) (Aquaculture –short term – for a period of six months).
- CMFRI won 5 awards at International Aquashow, 2008 organised at Kaloor International stadium during Feb1-5th 2009.
- Dr. Joe. K. Kizhakudan has won the Best presentation award for papers presented at the Hindi Workshop on Recent Advances in Aquaculture conducted by CIBA, on at Chennai September 23-24 2008.

International Recognition

- The publication " A systematic appraisal of hard corals depicting the results of the research work carried out in the Gulf of Mannar Biosphere Reserve, has gained international recognition by getting enlisted in the **'UN Atlas of the Oceans'.** (Ref.No.http://*www.oceanatlas.org/id*/190744)

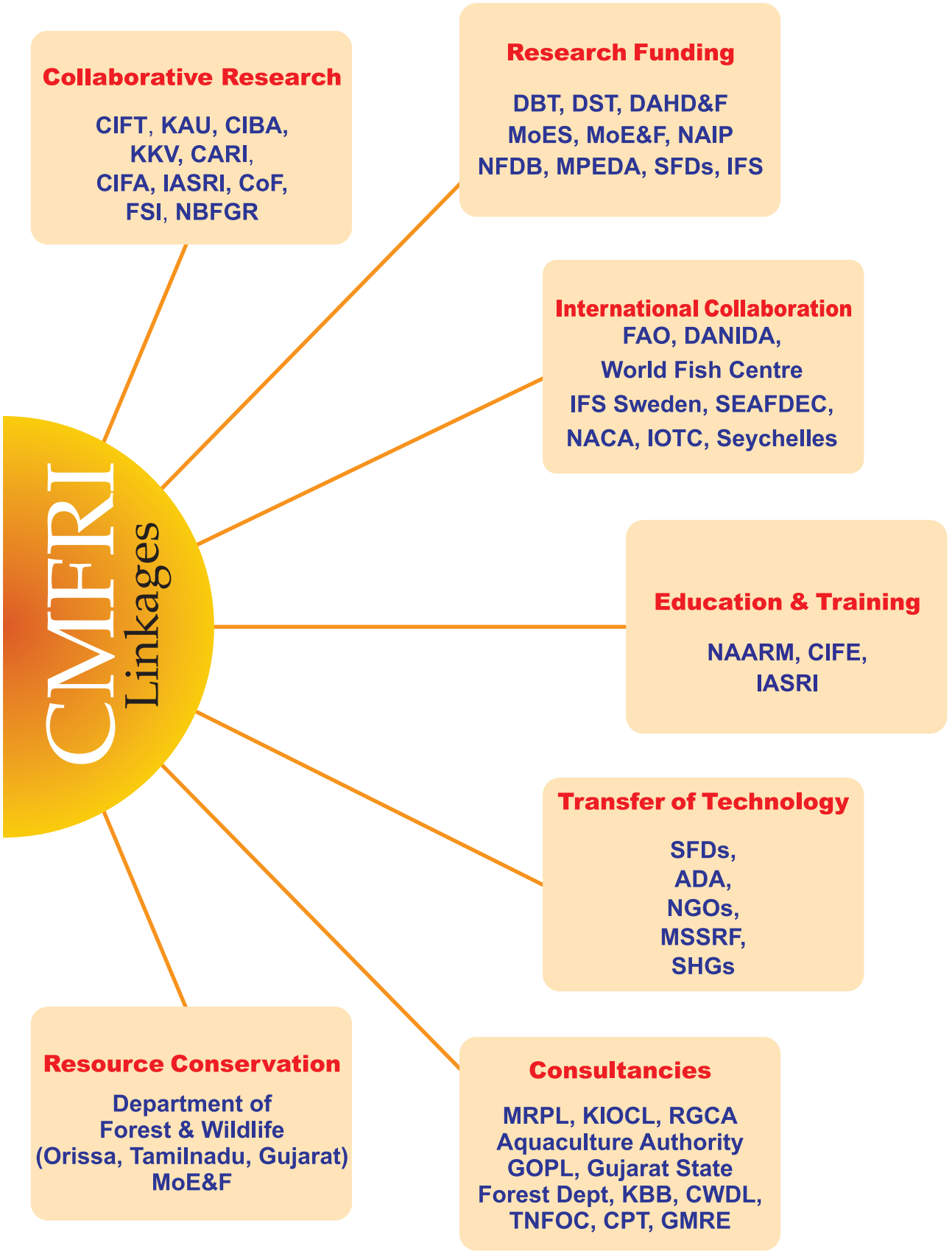
Commonwealth Fellowship

- Smt. Sandhya Sukumaran, Scientist, Marine Biodiversity Division has been awarded the 'Commonwealth Fellowship-2008' to pursue Doctoral Studies at the School of Environmental Studies, University of East Anglia, Norwich, UK. She is working on the topic 'Aquatic Pollution and Marine Biodiversity' under Dr. Alastair Grant, Director, Centre for Ecology, Evolution and Conservation, University of East Anglia.

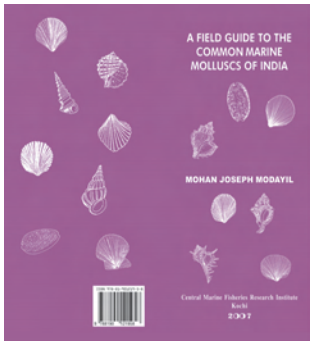
'Akhil Bharatiya Hindithar Bhashi (Vishesh) Puraskar'

- In the '*Akhil Bharatiya Vaigyanik avum Techniki Vishayom par Hindi lekh Pratiyogitha*' conducted by Kendriya Sachivalay Hindi Parishad, New Delhi, Smt. Rekha J. Nair won the '*Akhil Bharatiya Hindithar Bhashi (Vishesh) Puraskar* for the best research paper from non-Hindi speaking States. The award was presented on February 26, 2009 at Teen Murti Bhavan by Union Cabinet Minister.

Smt. Rekha J. Nair receiving the award


CMFRI Linkages
Collaborative Research
CIFT, KAU, CIBA, KKV, CARI, CIFA, IASRI, CoF, FSI, NBFGR
Research Funding
DBT, DST, DAHD&F MoES, MoE&F, NAIP NFDB, MPEDA, SFDs, IFS
International Collaboration
FAO, DANIDA, World Fish Centre IFS Sweden, SEAFDEC, NACA, IOTC, Seychelles
Education & Training
NAARM, CIFE, IASRI
Transfer of Technology
SFDs, ADA, NGOs, MSSRF, SHGs
Consultancies
MRPL, KIOCL, RGCA Aquaculture Authority GOPL, Gujarat State Forest Dept, KBB, CWDL, TNFOC, CPT, GMRE
Resource Conservation
Department of Forest & Wildlife (Orissa, Tamilnadu, Gujarat) MoE&F

Publications



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A Value Chain on Oceanic Tuna Fisheries in Lakshadweep Sea. Brochure, Central Marine Fisheries Research Institute, Kochi.

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Workshops Seminars and Training Programmes Organised

- "Skill enhancement training-cum-workshop on field data collection for estimation of marine fish landings" for the field staff of south west region consisting of marine states of Kerala, Karnataka and Goa – 10-12 November 2008 at CMFRI, Kochi.
- "Skill enhancement training-cum-workshop on field data collection for estimation of marine fish landings" for the field staff of north east region consisting of Andhra Pradesh, Orissa and West Bengal – 17-19 November 2008 at Regional Centre of CMFRI, Visakhapatinam
- "Skill enhancement training-cum-workshop on field data collection for estimation of marine fish landings" for the field staff of north west region consisting of marine states of Maharashtra and Gujarat – 16-18 March, 2009 at Mumbai Research Centre of CMFRI, Mumbai.
- "Skill enhancement training-cum-workshop on field data collection for estimation of marine fish landings" for the field staff of south east region consisting of marine states of Tamil Nadu and Andhra Pradesh 16-18 March, 2009 at Chennai Research Centre of CMFRI, Chennai.
- Training programme on "Fish stock assessment – Methods and solutions" was organized for the technical staff of CMFRI HQs, Research and Regional Centres of CMFRI – 13-24 October 2008, at CMFRI, Cochin.
- Training programme for five apprentice trainees under the State Govt. in Programming and Systems Administration Assistant (PASAA) Scheme which has been initiated into a six month IT applications training module from October 2008.
- Training program on "MS Excel and MS Access" for Administrative staff of CMFRI HQs – 17-22 and 24-29 November 2008 at CMFRI, Cochin.
- Training program on "MS Excel and MS Access" for Administrative staff of CMFRI HQs – 24-29 November 2008 at CMFRI, Cochin.
- Training programs on "Fundamentals of computers and document management" for supporting staff of CMFRI HQs and Research Centres – 20-21 March 2009 at CMFRI, Cochin.
- National Seminar on Biodiversity Regime-Emerging Challenges and Opportunities – 22 May 2008 at Mangalore RC.

- Outreach programme on World Environment Day on the theme "Kick the Habit-towards a Low Carbon Economy", under the aegis of the Network Project on Climate Change – 5th June 2008 was organised at Mangalore RC.
- Data Crunch Workshop - Data Analysis Using Sigma Plot Software at Mangalore RC – 9th July 2008.
- Marine life Quiz and Marine Life Painting Competitions for School Children Mangalore RC, July –August 2008.
- National Official Language Seminar on " Marine Fisheries of Andharapradesh" – 29-9-08 at Visakhapatnam RC.
- Three awareness campaign on fish culture in open sea cages for the local fishermen of
- Gopalpur, Ganjam Dist of Orissa – 30 August 2008 of Visakhapatnam Regional Centre
- Rangampetta, Kothapilli Mandal, Kakinada Dist of AP on 22 September 08 at Visakhapatnam Regional Centre.
- Kothuru, Sompeta Mandal., Srikakulam District of AP – 15 October, 2008
- Zonal Workshop on skill development for FRAD survey staff of Andhrapradesh, Orissa and West Bengal region from 17- 19th Nov 2008.

Participations

- The India International Sea Food Exposition at Cochin by Sea Food News during 8th to 10th March 2008.
- Exhibition at Gramasree at Alappuzha – 20th to 28th April, 2008.
- The Indian Expo at Cochin – 18th to 20th July, 2008.
- The Exhibition held at Toc H Public School at Cochin – 25th to 26th September 2008.
- Exhibition on 'Fishing Behaviour' – CIFE, Mumbai, 16th to 17th October 2008.
- Exhibition of Indian Fisheries Forum Kolkotta – 22nd to 26th November 2008.
- Exhibition held by TIE, Kerala at Cochin – 31st November 2008.
- Exhibition held by Neuro Biology & Neuro Informatics (NBNI) – 9th to 14th December 2008, Cochin.
- Exhibition held at Matsyabhavan, Thalikkulam – 26th to 28th December 2008.
- Exhibition INDAQUA – 21st to 23rd January 2009, Bhubaneswar.
- Exhibition 'Matsyamela' – 13th to 15th February 2009, Mangalore.
- Exhibition of 'Bharat Nirman' at Kottakkal Gram Panchayat Hall, Malappuram – 15th to 19th February 2009 organised by the Press Information Bureaue.
- Exposition of INDAQUARIA – 18th to 20th February 2009, Kolkotta.

- Exhibition 'AQUA SHOW 09' held at Women's Association Hall, Kochi – 28th February to 1st March 2009.
- A Winter school on Recent Advances in breeding and larviculture of marine finfish and shellfish was organised for 21 days from 30-12-2008 to 19-1-2009.
- Training was given to fishermen to construct pen enclosures. Training was also given in mussel mariculture at Kottakadavu (Near Badagara) and Payyanur (Kannur district).
- Conducted training to vocational students of Narrakal on seaweed cultivation and utilization.
- Four day workshop for preparation of a 'Monograph on Carangidae' at Headquarters, Cochin – 12th to 16th May 2008, Marine Biodiversity Division.
- The International Biodiversity Day was observed by the Marine Biodiversity Division of CMFRI by organizing a Workshop on **'Marine Biodiversity: Today and Tomorrow',** on 22nd May 2008 at CMFRI, Cochin for Post Graduate Students and Research Scholars (Biological Science).

Approved Ongoing Projects

In-house/Inter-Divisional Projects

Sl.No.	Project Code	Title	Name of PI
1	FRA/ASSESS/01	Development of knowledge based information system for marine fisheries sustainability	Dr. T .V. Sathianandan
2	FRA/ASSESS/02	Decision support system for marine fisheries management	Dr. J. Jayasankar
3	FRA/IDP/01	Sustaining marine fisheries of Kerala - a multidimensional scaling approach	Dr.J.Jayasankar
4	PEL/IDP/01	Management advisories for sustaining marine fisheries of Kerala and Lakshadweep	Dr. N.G.K. Pillai
5	PEL/IDP/02	Management advisories for sustaining marine fisheries for Karnataka & Goa	Dr. A.P. Dinesh Babu
6	PEL/IDP/03	Strategies for sustaining tuna fisheries along the coast of India	Dr.E.M. Abdussamad
7	DEM/IDP/01	Management advisories for sustaining marine fisheries of Tamil Nadu and Pudicherry	Dr. P.U.Zacharia
8	DEM/IDP/02	Development of management advisories for sustaining marine fisheries of Gujarat	Dr. G. Mohanraj
9	CF/IDP/01	Management advisories for sustaining marine fisheries of Maharashtra	Dr. V.D. Deshmukh
10	CF/IDP/02	Resource damage assessment in marine fisheries: impact of selective fishing of juveniles and bycatch and discards in trawl fisheries	Dr. E.V. Radhakrishnan
11	CF/RE/03	Dynamics of recruitment process of penaeid prawns along the Indian coast	Dr.V.D.Deshmukh
12	MF/CAP/01	Developing management advisories for sustaining marine fisheries of Andhra Pradesh	Dr. G. Syda Rao
13	MF/IDP/02	Application of trophic modeling in marine fisheries management	Dr. K.S. Mohamed
14	FEM/01	Impact of anthropogenic activities on coastal marine environment and fisheries	Dr. P. Kaladharan
15	FEM/02	Impact and yield study of environmental changes on distribution shifts in small pelagics along the Indian coast	Dr. K. Vijayakumaran
16	SEE/PMS/01	A diagnostic study on dimensions, causes and ameliorative strategies of poverty and marginalisation among the marine fisherfolk of India	Dr. C. Ramachandran
17	SEE/PEM/01	Benefit cost assessment of marine fishery business and alternative investment options	Dr. R. Narayanakumar
18	MD/IDP/01	Technology development for seed production of shellfish	Dr. K.R. Manmadhan Nair
19	MD/IDP/02	Development of diversified mariculture systems	Dr. V. Kripa
20	MD/IDP/03	Development of broodstock, captive breeding and seed production techniques for selected marine food fishes and ornamental fishes	Dr. G. Gopakumar
21	MBD/RE/01	Understanding the threatened coral reef ecosystems of southern India and designing interventions aimed at their restorations	Dr. Mary K. Manisseri
22	MBD/RE/04	Species variation and biodiversity of fishes of the family Lutjanidae in the Indian seas	Dr.K.K. Joshi
23	MBTD/NUT/01	Formulation and evaluation of larval and grow out feed for marine crabs, lobsters, ornamentals and cage farmed finfish	P. Vijayagopal
24	PNP/BIOT/02	Biotechnological applications in mariculture and conservation	P.C. Thomas
25	MBTD/PATH/01	Pathogen profiling, diagnostics and health management in maricultured finfish and shellfish	Dr.K.K.Vijayan

Sponsored Projects

Sl. No.	Name of the Project	Sanctioned Amount (Rs in lakhs)	Funding Agency	Date of start	Status
1.	Farming and pearl production in the black lip pearl oyster Pinctada margaratifera	130.00	DOD	April, 2003	Ongoing
2.	Economic evaluation of trawl fishing in Andhra Pradesh and Kerala	19.35	ICAR AP Cess fund New Delhi ADG (ESM)	August, 2004	Ongoing
3.	Floating cage farm for marine fish and shellfish	237.37	MoA	September, 2005	Ongoing
4.	Development of gene constructs for production of WSSV resistant penaeid shrimp and its validation in shrimp cell culture system	17.27	ICAR	November, 2005	Ongoing
5.	Development and application of CMG family Recombinant Hormones, their Antagonistics and RANi Technique for induced maturation and spawning Penaeus monodon	38.36	DBT	November, 2005	Ongoing
6.	Investigation on 'Loose Shell Syndrome' among farmed tiger shrimp Penaeus monodon	30.02	ICAR APCESS (Network)	December, 2005	Ongoing
7.	Seed production in agricultural crops and fisheries	134.00	ICAR	January, 2006	Ongoing
8.	Impact of fisheries Research in India	30.14	ICAR	April, 2006	Ongoing
9.	Establishment and chararacterization of cell lines from the rabbit fish, Siganus *canaliculatus* and the marine ornamental fish *Dascyllus trimaculatus*	25.02	DBT	July 2008	Ongoing
10.	Assessment of Myctophid resources in the Arabian sea and development of harvest and post harvest technologies	45.46	DOD	2008	Ongoing
11.	Assessment of fishery resources along the Indian continental slope and central Indian ocean	141.13	DOD	2008	Ongoing
12.	Studies on marine mammals of Indian Exclusive Economic Zone and the contiguous seas (IInd Phase)	52.00	DOD	2008	Ongoing
13.	Impact, adaptation and vulnerability of Indian Agriculture to climate change (IInd Phase)	22 (amount sanctioned by the funding agency only for one year)	ICAR APCESS (NETWORK)	2008	Ongoing
14.	Commercialization of marine pearl culture	63.00	DOD	2008	Ongoing

15.	Study on demonstration of responsible fishing practices for the trawl fisheries of Gujarat State	22.00	MPEDA	2008	Ongoing
16.	Open sea cage culture demonstration farms in India	104.30	NFDB	2008	Ongoing
17.	A value chain on oceanic tuna fisheries in Lakshadweep sea	638.54	World Bank/ NAIP	July 2008	Ongoing
18.	Utilization strategy for oceanic squids (Cephalopoda) in Arabian Sea	541.30	PIU, NAIP	March, 2009	Ongoing
19.	A value chain on high value shellfishes from mariculture systems	354.11	PIU, NAIP	February, 2009	Ongoing
20.	Export oriented marine value chain for farmed sea food production using Cobia through rural entrepreneurship	5.80	PIU, NAIP	March, 2009	Ongoing

In-house Projects Approved in the 16th SRC Meeting during March 2009

1	Clean development mechanism (CDM) for marine fisheries	Dr.E.Vivekanandan
2	Impact of WTO regulations in Indian fisheries trade: a policy perspective	Dr.Shyam S. Salim
3	Innovations of sea cage farming and development of sustainable Capture Based Aquaculture (CBA) systems	Dr.G.Syda Rao
4	Conservation mariculture of selected species	Dr.I. Jagadis
5	Assessment of biodiversity and ecological impact in open sea cage farming	Dr.K.Vinod

Consultancies

Consultancies during the year 2008-2009

Sl.No	Name of Client	Project Title	Duration	Amount (Rs.)
1	M/s. Project Implementation Agency A -Block, PKC Educational complex Anna Nagar pondicherry-605005.	Socio Economic survey of Fishermen in Pondicherry and Karickal regions.	Aug.2008-Oct.2008	999932
2	ANZDEC Limited Consultants PO Box 99-608, Auckland, New Zealand	Project preparatory assistance for the sustainable coastal protection and management project of GOI funded by ADB.	Aug.2008-Apr-.2009	1029375
3	Surat Municipal Corporation, Surat, Gujarat.	Installation of water purification and life support systems, ecosystem development and live stock malignance in the Marine aquarium at Surat (Phase-II)	Sep.2008 Aug.2010	2323189
4	M/s.GMR Energy Ltd, Mangalore	Monitoring studies on the hy drobiological conditions in the Arabian Sea off Thanirbavi, near the marine outfall of Thanir bavi Power Plant Facility M/sGMREL, Mangalore (Phase-7)	Dec.2009-May2009	448316
5	RGCA, Kodiyaghat, Burmanala P.O, Garacharma, Andaman 744105	Shrimp nutrition for specific pathogen free (SPF) tiger shrimp.	Feb.2009-Jan.2010	279962
6	M/s. Chennai Water Desalination ltd, Guindy, Chennai-600032.	Installation of artificial reef to enhance biological resources and livelihood of fishermen	Feb-2009-April-2009	1694009
7	NEERI Nagpur-440020.	Marine environmental survey at Puducherry Port-EI and RA for the development of existing Puducherry Port in to deep water modern port.	March 2009-June 2009	3772300
			Total	**1,05,47,083**

Meetings

Recommendations of 13th Research Advisory Committee (RAC) Meeting held at CMFRI Cochin on 27.12.2008

- CMFRI may estimate the Potential Yield and suggest Maximum Fleet Size for each maritime state together with catch quotas for important species.
- CMFRI may critically analyse fisheries data on the impact of seasonal ban on fishing and recommend suitable measures including the possibility of catch quotas.
- Short films on endangered marine species and ecosystems may be produced for awareness building among the public.
- A project on marine algae may be taken up.
- CMFRI may investigate whether the ban on sea cucumbers has helped replenishment of the stock. CMFRI may seek the permission of the MoEF to demonstrate the available technologies to entrepreneurs to establish hatcheries and grow-out facilities for commercial production of sea cucumbers and thereby contain clandestine exploitation of the valuable resource from Nature.
- A marine gene bank may be established in collaboration with NBFGR.
- Commercialisation of ornamental fish hatchery and feed technologies may be taken up on a priority.
- Open sea cage culture by using small cages may be developed in association with fishermen cooperatives.
- The Institute may develop and explore the possibility of patenting DNA probes for different marine species.
- Total Factor Productivity should be estimated by the Institute at the earliest.
- Research on gender issues in capture and culture fisheries needs attention.
- Considering the success of mussel farming along the southwest coast, CMFRI may popularize the technology along the coastline further north.
- CMFRI may publish a series of monographs on taxonomy of marine organisms.
- The Institute may take up research on the impact of Marine Protected Areas on biodiversity in collaboration with NBFGR.
- The species profile of trawl catch in different maritime states may be analysed and published.
- Considering the large amount of vacancies in the scientific cadre, the RAC recommends filling up of vacancies at the earliest so that the research programmes of the Institute are not affected.

STAFF RESEARCH COUNCIL MEETING

The 16th SRC meeting was held at Regional Centre of CMFRI, Mandapam Camp from 2-6 March, 2009. 94 Scientists including Principal Investigator, Co-PIs and Head of Divisions participated in the meeting and presented the progress reports and the progress was evaluated. New projects were presented and 5 projects were approved.

67th IMC

The Member Secretary presented the Action Taken Report on the items considered during the previous meeting held on 29.09.2008 at CMFRI Kochi as under: -

1. Approval of. Annual Plan of "Works" for the year 2008-09 under XI Plan and Non-Plan

   Rs.160.00lakhs was allotted under plan for "work" for the financial year 2008-2009. Rs.107.00lakhs has already been spent for 'works' under plan. Action has -already been initiated to deposit the balance amount of Rs.53.0lakhs to CPWD. List of items under "works" and amount spent is shown in Annexure-1. Considering the 5% deduction imposed on the total allocation of Rs.37.001akhs, the allocation for 'works' under Non-plan for the year 2008-2009 become Rs.35.10 lakh. Rs.32.751akh has already been spent. Action has already been taken to utilize the balance amount.

2. Approval for undertaking the work at Mandapam under "Farm Development" under "Works" within the allotted budget of Rs.50.00 lakhs.

   Under XI Plan EFC Rs.50.001akh was allotted under "Works" for "Farm Development" at Mandapam. Out of this Rs.15,47,0007- was utilized during the financial year 2008-2009 for fabrication of cages (5 Nos.) at Mandapam.

3. Approval of Annual Plan for procurement of equipments for the year 2008-09 under XI Plan

   Procurement action as already been completed in the case of many equipments and action for procurement of the remaining equipment is in progress. The exact position will be placed before the IMC in its next meeting.

4. Nomination of Grievance Committee Member

   Smt. Roja Sethumadhavan, SAO has been nominated as the member of Grievance Committee vide this office order No.6-l/2007-Estt, dt.05.12.2008

SCIENTIFIC ADVISORY COMMITTEE MEETING - KVK

The First meeting of the reconstituted Scientific Advisory Committee of the Krishi Vigyan Kendra was held at Central Marine Fisheries Research Institute Headquarters, Cochin on 24 February, 2009.

Participation of Scientists in conferences, meetings, workshops, symposia and training in India and abroad

Dr.G.Syda Rao, Director participated in the following meetings

Award function and received the best ICAR Institute Award of CMFRI **"Sardar Patel Outstanding Institution Award, 2007**" from the Hon'ble Minister for Agriculture on 16th July, 2008 at New Delhi.

Workshop of the Experts at the National Knowledge Commission, Govt. of India, New Delhi on 29th July, 2008.

Meeting on "Peninsular Fisheries and Aquaculture at the Bangalore Centre of CIFA & CIFRI, Hessaraghatta, Bangalore on 23rd August, 2008.

Workshop on Strategies for conservation and resource enhancement of sea cucumbers in Indian Seas, held at CIBA, Chennai on 25th August, 2008.

Workshop on "Marine Fisheries of Karnataka" at College of Fisheries, Mangalore on 30th August, 2008 and also attended the Lease Deed Signing Ceremony on the same day.

First meeting of Expert group to review the Deep Sea Fishing held on 1st September, 2008 at Krishi Bhavan, New Delhi.

Meeting of "National Expert Consultative Conference on Fisheries Lease Policy" at Sandesh Hallo, Hotel Savera, Chennai on 4th September, 2008.

Mmeeting with Lakshadweep Administrator, Lakshadweep Administrative Office at Willingdon Island, Kochi on 19th September, 2008.

Cage Culture presentation at NFDB, Hyderabad on 26th September, 2008.

Ninth Technical Advisory Committee Meeting (TAC 9) from 30th October to Ist November, 2008 at **Shangai, China**.

8th Indian Fisheries Forum Meeting from 22nd to 25th November, 2008 at Kolkata.

International Symposium on Marine Ecosystems Challenges and Opportunities (MECOS- 2009) at Hotel Presidency, Ernakulam North, Kochi during 09th to 12th February, 2009.

Scientific Advisory Committee Meeting of KVK at CMFRI, Kochi on 24th February, 2009.

Regional seminar in connection with the Silver Jubilee Celebrations of Matsyafed at CMFRI ATIC Hall on 27th February, 2009.

Scientists of the Institute participated in the following meetings, workshops, symposia and training programmes

"WTO and its impact on Indian seafood trade" at CIFT, Cochin on 28th June 2008 – **Dr. T.V. Sathianandan, Dr. J. Jaysankar**

Workshop on "Bayesian statistics using OpenBUGS and R" held at the Department of Statistics, St. Thomas College, Pala, Kerala during 08-12, December, 2008 – **Dr. T. V. Sathianandan, Dr. J. Jaysankar**

National Workshop on "Development of Fisheries Information System Network (FISHNET) " organized by the Department of Animal Husbandry, Dairying & Fisheries (DAHD&F) and the National Informatics Centre (NIC) at NASC Complex, Pusa, New Delhi on 21-1-2009 – **Dr. T. V. Sathianandan**

6th meeting of the Technical Monitoring Committee for Central Sector Scheme on "Strengthening of database and geographical information system for the fisheries sector" organized by the Department of Animal Husbandry, Dairying and Fisheries at Central Inland Fisheries Research Institute, Barrackpore. Kolkata on 12-02-2009 – **Dr. T. V. Sathianandan**

First meeting of "Expert Group" to review the deep sea fishing guidelines at Krishi Bhawan, New Delhi on 1st September, 2008 – **Dr. J. Jayasankar**

Meeting with the Officials of Lakshadweep Fisheries Department under the NAIP "A value chain on Oceanic tuna fisheries in Lakshadweep sea" at Agatti/Kavaratti from 24-11-2008 to 4-12-2008 – **Dr. J. Jayasankar**

Meeting on "Fisheries – Committee for registration of fishing vessels" with the National Informatics Centre (NIC), at Thiruvanantharapuram on 15-1-2009 **–Dr. J. Jayasankar**

Training programme on "Project monitoring and evaluation" under the aegis of NAIP conducted by NAARM, Hyderabad from 30-3-09 to 4-4-09 – **Dr. J. Jayasankar**

National Official Language seminar on "Coastal zone management" at CMFRI, Cochin on 30th May 2008 – **all Scientists at Headquarter, CMFRI**

International symposium MECOS 09" at Ernakulam, Cochin during 09-12, February, 2009 – **all Scientists of CMFRI**

"Skill enhancement training-cum-workshop on field data collection for estimation of marine fish landings" for the field staff of south west region consisting of marine states of Kerala, Karnataka and Goa at CMFRI, Kochi during 10-12, November, 2008 – **Dr.Somy Kuriakose, Dr. T. M. Najmudeen, Smt. Mini K. G, Shri. Wilson T. Mathew, Smt. Rekha J. Nair, Dr. Rani Mary George**

Attended the "Zonal workshop cum skill enhancement training" for Field staff of Tamil Nadu conducted at Madras Research Centre of CMFRI, Chennai during 16-18 March, 2009 - **Dr. T. M. Najmudeen**

Zonal workshop cum skill enhancement training for Field staff of Maharashtra and Gujarat conducted at Mumbai Research Centre of CMFRI, Mumbai during 16-18 March, 2009 - **Shri. Wilson T. Mathew**

Meeting with the Hon'ble Administrator, U.T. of Lakshadweep at Kavaratti during 7tht May, 2008 to discuss the implementation of the NAIP Project – **Dr. N. G. K. Pillai**

National Seminar on 'Biodiversity Regimes – Emerging Challenges and Opportunities' organized in connection with the International Biodiversity Day at Mangalore Research Centre on 22nd May, 2008 – **Dr. N. G. K. Pillai**

Task Force Meeting on Aquarium Reforms constituted by Hon'ble Fisheries Minister, Govt. of Kerala at Govt. Secretariat, Trivandrum on 26th May, 2008 - **Dr. N. G. K. Pillai**

Brainstorming Session on ' Development of Island Fisheries and presented a paper entitled 'Development of tuna fisheries in Andaman and Nicobar Islands' at CARI, Port Blair on 19th – 22nd June, 2008 - **Dr. N. G. K. Pillai**

Meeting with the Principal Chief Conservator of Forests and Chief Wildlife Warden, Tamil Nadu at Chennai on 26th June, 2008 - **Dr. N. G. K. Pillai**

First Meeting of 'Expert Group' to review the Deep sea Fishing Guidelines – Meeting chaired by Deputy Director General (Fy.), ICAR at DADH&F, Krishi Bhavan, New Delhi on 1st September, 2008 - **Dr. N. G. K. Pillai**

Second Meeting of the 'Expert Group to review the Deep Sea Fishing Guidelines', at New Delhi from 30 September – 1 October, 2008 - **Dr. N. G. K. Pillai**

National Seminar '*Harvest and Post-harvest technology for tuna'* organized by Society of Fishery Technologies (India) at CIFT, Kochi on 24 July 2008 - **Dr. N. G. K. Pillai**

Launching of NAIP Project on "A Value Chain on Oceanic tuna fisheries in Lakshadweep sea at CMFRI Kochi on 12th – 13th August, 2008 – **all Scientists of CMFRI**

National Seminar on 'Problems and prospects of marine fisheries in Kerala' organized by Matsyafed, Govt. of Kerala at Thrissur on 24 February 2009 - **Dr. N. G. K. Pillai**

Workshop of the MoES project "Commercialization of Marine Pearl Culture at CMFRI, Cochin on 27th May 2008 – **Shri. K. P. Said Koya**

NAIP meeting of M & E Consultants and Consortium Investigators at CMFRI, Cochin on 22nd October, 2008 - **Shri. K. P. Said Koya**

Seminar on '***Harvest and post-harvest technology for tunas***" organized by Society of Fisheries Technologists (India)at CIFT Kochi on 24th July, 2008 – **Dr. N. G. K. Pillai, Dr. E. M. Abdussamad, Smt. U. Ganga**

One day seminar on '***Global Recession and Fisheries Industry in India***" organized by College of Fisheries (KAU), Kochi at College of Fisheries (KAU), Kochi 12th December 2008 - **Dr. E. M. Abdussamad**

Workshop on "Assessment and Management of Offshore Fisheries Resources in South and Southeast Asia" organized by FAO at Bangkok during June 17-19, 2008 - **Dr. E. Vivekanandan**

International Symposium on "Climate Change and Food Security in South Asia" organized by World Meterological Organization and FAO at Dhaka during August 25-30, 2008 - **Dr. E. Vivekanandan**

Workshop on Fisheries Management and presented a paper on "Overview of Indian fisheries – Fisheries Management with ecosystem approach" organized by SIFFS, Trivandrum at Asir Bhavan, Ernakulam on 22nd April 2008 - **Dr. E. Vivekanandan**

National Seminar "Biodiversity regime : Challenges and Opportunities" conducted by Mangalore Research Centre of CMFRI, Mangalore on 22nd May 2008 - **Dr E. Vivekanandan, Dr. K. S. Mohamed, Dr. K. K. Vijayan**

Delivered Special talk on "Climate change" in the UGC sponsored National Seminar on Climate Change at VSR College, Tenali on 31st July, 2008 - **Dr. E. Vivekanandan**

Workshop on "Strategies for conservation and resource enhancement of sea cucumbers in Indian Seas" conducted by CMFRI at Chennai on 25th August 2008 – **Dr. Mohanraj, Smt. Sobha J. Kizhakudan, Dr. P. Muthiah, Dr. Margaret Muthu Rethnam, Dr. G. Gopakumar, Dr. Joe K. Kizhakudan**

Expert Committee meeting to finalise the draft amendments to Tamil Nadu Marine Fisheries Regulations Act – 1983 organised by the Department of Fisheries, Govt. of Tamil Nadu at GRT, Chennai on 9th January 2009 - **Dr. Mohanraj**

Idea Generating Workshop on "Aquaculture Biotechnology" as an invited member of workgroup I on Production Technologies organized by DBT, New Delhi and CIFE, Mumbai on 29th August, 2008 – **Dr. V. V. Singh, Smt. Paramita Banerjee Sawant**

32nd Conference of the Ethological Society and National Symposium on Fish Behaviour and presented a paper on "Detrimental behavioral characteristics of catfishes : An analytical review" organized by the Ethological Society, Bijapur and Indian Fisheries Association, Mumbai on 16-17 October, 2008 - **Smt. Paramita Banerjee Sawant**

National Conference on Aquatic Genetic Resources and delivered a lecture on Indian Molluscan Resources: Taxonomic Status, Research Challenges and Conservation Needs during April 26-27, 2008, NBFGR, Lucknow - **Dr. K. S. Mohamed**

Training programme organized by GJEPC (Gem and Jewellery Export Promotion Council, Chennai) for Shell Craftsmen of A&N Islands on Mabe pearl production from *P. margaritifera* during 7.5.08 to 13.5.08 at Port Blair- **Dr. K. S. Mohamed**

Project launch meeting - Project Preparatory Technical Assistance for coastal protection structures at Calangute, Goa, 16-17 August 2008 conducted by Asian Development Bank (ADB) - **Dr. K. S. Mohamed**

Brainstorming meet to discuss different aspects and activities of 'Peninsular Fisheries and Aquaculture' on 23rd August, 2008 at CIFRI/ CIFA, Bangalore - **Dr. K. S. Mohamed**

One day workshop on "Strategies for conservation and Resource enhancement of sea cucumbers in Indian seas" on 25.8.2008 at CIBA, Chennai organized by CMFRI., Kochi - **Dr. P. Muthiah**

Participated in the discussion of Science & Technology Policy for Tamil Nadu, Tuticorin on 20.12.2008 conducted Science & Technology Policy Board, Chennai - **Dr. P. Muthiah**

Deputation training sponsored by the DST for Five days Exposure to scientific labs/Institutions in Taiwan Under ''National Progamme of training of Scientists and Technologists working in Govt. Sectors as a part of twelve week Foundation Training Programme held during 1 – 5 september 2008 - **Dr. V. Venkatesan**

Short Term Training Course on "Isotope Tracer Techniques for Water Resources Development and Management from 14th to 19th January, 2008, organized by CWRDM, Kozhikode - **Dr. D. Prema**

ICAR Winter School on "Impact of climate change on Indian marine fisheries"- Jan 18th to February 7th, 2008 – **Smt.Bindu Sulochanan, Dr.K.S.Sobhana, Dr. V. Kripa**

Meeting regarding Rewas and Vasai Consultancy project at Maharashtra Maritime Board at MMB Office, Mumbai on 18. 02.2008 - **Dr. V. V. Singh**

Regional Workshop of the North-West Region for the project based on "Ecosystem Based Fisheries Management" from 25.02.2008 to 29.02.2008 - **Dr. V. V. Singh**

Participated in the meeting regarding Tarapur Project held at Nuclear Power Corporation on 23.06.2008 - **Dr. V. V. Singh**

Participated in the meeting with the Commissioner of Fisheries, Maharashtra State, regarding Cage culture project at Taraporevala Aquarium, Marine Lines, Bombay on 10.12.2008 - **Dr. V. V. Singh**

Presented lecture on "Recent Trends in coastal and Marine Environment Research around Mumbai" on 13.03.2009 organized by IIT, Mumbai - **Dr. V. V. Singh**

Lecture on "Bioactive compounds from holothurians" at the National Seminar on Bioactive Compounds from Marine Organisms held at Department of Marine Biology, Microbiology and Biochemistry, School of Ocean Science and Technology, Cochin University, Kochi, Kerala. on 15th Mar'08 – **Dr. P. S. Asha**

Inception workshop of the TA-4965-IND Sustainable Coastal Protection and Management Project of ADB at Goa on 16 and 17 of August 2008 - **Dr. K. Vijayakumaran**

National Seminar on Global Warming and the Ways and means of Mitigating its Impact at AJK College of Arts and Science, Coimbatore 19-20 September 2008 and presented a paper "Impact of global warming on marine fisheries and ecosystems"- **Dr. K. Vijayakumaran**

Regional Seminar on Fisheries Sector at Kasaragod on 17 February 2009, organized by Matsyafed, Kasaragod District and moderated the Seminar- **Dr. K. Vijayakumaran**

Coordination meeting with INCOIS and Centre for Studies on Bay of Bengal, Andhra University, Visakhapatnam on 15-9-2008 - **Dr. P. Kaladharan**

Workshop on sustainability study of Visakhapatnam City at Visakhapatnam organized by the Andhra University in collaboration with SIPU international, Stockholm, Sweden on 29-1-2009 - **Dr. P. Kaladharan**

Meeting at CIFT Research Centre Visakhapatnam on 2-2-09 arranged with the Director of Fisheries, Dept of Fisheries, Govt of AP for a project on MPEDA by the IIM, Ahmadabad - **Dr. P. Kaladharan**

Expert Committee meeting of Kerala State Biotechnology Board, Kerala State council for Science, Technology and Environment at Sastra Bhavan, Pattom, Thiruvananthapuram on 25th September 2008 - **Dr. K.K. Vijayan**

'International Workshop on DNA Barcoding' at National Agricultural Science Complex, Pusa, New Delhi organized by Aquatic Biodiversity Conservation Society and National Bureau of Fish Genetic Resources of ICAR on 4th December 2008 - **Dr. K.K. Vijayan**

2nd meeting of the sub-committee for studying the potential and viability of culturing endemic and exotic species held at CIBA, Chennai during 8-11 January 2009 - **Dr. K.K. Vijayan**

Brain storming session on "Exotic aquatic animals and quarantine" during 14-15 Feb 2009 at Lucknow - **Dr. K.K. Vijayan**

SAP meeting at Chennai and made a powerpoint presentation during 16-17 Feb 2009 - **Dr. K.K. Vijayan**

Brain storming work-shop on 'Prospects of Asian seabas fish farming' on 29-08-2008 at CIBA Chennai - **Dr. D. Kandasami**

All meetings associated with the ICAR Outreach Activity on Fish feeds at CICFRI, Barrrackpore from February 26-27, 2009 - **Dr.P. Vijayagopal Dr. K.S.Sobhana**

8th Indian Fisheries Forum jointly organized by the Asian Fisheries Society, Indian Branch; CIFRI Barrackpore and the Inland Fisheries Society of India, November 22 – 26, 2008, Kolkotta, India – **Dr.K.S.Sobhana,Dr.Reeta Jayasankar, Dr.Boby Ignatius, Dr.Mary K.Manissery and Dr.Rani Mary George**

Served as resource person in the training programme for Local Competent Authority testing and certification of ornamental fishes for export organized by the Cochin University of Science and Technology and delivered a lecture on the topic "Clinical symptoms and pathology of diseases" on 21st October, 2008 - **Dr.K.S.Sobhana**

Served as resource person in the Winter School on "Recent advances in Breeding and Larviculture of finfish and shellfish" organized by the Mariculture Division of the Central Marine Fisheries Research Institute during 30th December 2008 to 19th January, 2009, and delivered a lecture on the topic "Fish cell lines and its applications for disease management in mariculture" - **Dr.K.S.Sobhana**

Workshop on Women in Aquaculture development by Coastal Aquaculture Society of India (CASI 0, Chennai & CIBA) participated on 29 & 30-07-08 - **Dr. Margaret Muthu Rethinam**

NAIP launch workshop " A Value chain on high values shellfishes from Mariculture system "held at CMFRI, Kochi on 26/03/09 - **Dr. Margaret Muthu Rethinam, Dr.V.P.Vipinkumar**

Winter school on 'Recent advances in fish and shell fish immunology and its applications' at CIFA, Bhubaneswar.from 21-10-2008 to 10-11-2008 - **Dr. S.R.Krupesha Sharma**

International symposium on 'Quality assurance in pathology and disease diagnosis' at IVRI, Izathnagar during 11-11-08 to 12-11-08 - **Dr. S.R.Krupesha Sharma**

National Consultation on Registration, evaluation, valuation and *in-situ* conservation of aquatic genetic resources at NBFGR, Lucknow during March 20-21, 2009 - **Dr. Srinivasa Raghavan**

Participated in the research project proposal formulation meeting at Fisheries Division of ICAR to discuss a programme on Assessment of literacy and actual levels of income from fisheries and aquaculture among marine & inland fishermen in the country convened by the DDG (Fy) ICAR on 15-09-08 - **Dr. R. Sathiadhas**

NFDB Project concluding workshop held at NCAP during February 11-12, 2009 - **Dr. R. Sathiadhas**

Brain storming meeting on " Aquaculture 2025" challenges and opportunities an CIFA, Bhubaneswar from7th to 8th June-2008 - **Dr. Sheela Immanuel**

Served as a Resource person for the training programme on Conservation of aquatic resources and environment in the maritime status of India for NETFISH during July 2008 - **Dr. R Narayanakumar**

Attended the lecture on DOHA round of WTO negotiations on Agriculture and its implications organized by Department of Agriculture (WTO cell) at Avenue Centre Kochi 30th August 200- **Dr. R Narayanakumar**

5thWorld Fisheries Congress, Yokohama, Japan, October 2008 and presented a Paper - **Dr.C.Ramachandran**

Served as resource person for handling a class on PRA and SHG for the training programme on conservation of aquatic resources and environment in the maritime status of India for NETFISH in two batches on 17th and 24th July, 2008 - **Dr.Vipinkumar, V.P, Dr.Aswathy.N**

Participated in ARTIFICIAL SEED PRODUCTION OF COBIA held at Research Institute for Aquaculture No. 1 (RIA 1), Ministry of Agriculture and Rural Development, Vietnam from 25th May 2008 to 25th June, 2008 - **Dr. G. Gopakumar**

Workshop on 'Sustainable harvest and green certification of wild caught indigenous ornamental fishery resources for export' at MPEDS, Kochi, 14-18 October, 2008 - **Dr. G. Gopakumar, Dr.V.Kripa, Dr.K.Madhu, Dr.Boby Ignatius**

Participated in ARTIFICIAL SEED PRODUCTION OF COBIA held at Research Institute for Aquaculture No. 1 (RIA 1), Ministry of Agriculture and Rural Development, Vietnam from 25th May 2008 to 25th June, 2008 - **Dr. K. Madhu**

Training on Seabass Breeding and Culture at CIBA, Chennai during 20 to 29th August 2008 - **Dr. Rema Madhu, Dr.M.K.Anil**

Workshop on "Antifouling Paint Effects" at National Institute of Ocean Technology, Chennai on 15th September 2008 - **Shri. C. Kalidas**

Participated and presented two papers at the Hindi Workshop on Recent Advances in Aquaculture conducted by CIBA, at Chennai on September 23-24 2008 – **Dr. Reeta Jayasankar, Dr. Joe. K. Kizhakudan**

Engineering Orientation Course for Fishery and Aquaculture scientists, Officers and teachers, IIT Kharagpur, September 2-12, 2008 - **Dr. Boby Ignatius**

Technical Advisory Committee Meeting of NAIP at Mumbai on October 17-18, 2008 - **Dr. V.Kripa**

Research Advisory Group (RAG) meeting of 'Gulf of Mannar Marine Biosphere Reserve Trust (GOMBRT)'at Chennai on 5-11-2008 - **Dr. V.Kripa**

RAC meeting of GOMBRT at Chennai in November, 2008 as a member to evaluate progress of work in the projects funded by UNDP through GOMBRT - **Dr. V.Kripa**

Participated in the Scientific Advisory Committee (SAC) meeting of MoES at Kochi on 2nd December, 2008 - **Dr. V.Kripa**

Capacity Building Programme of Gem and Jewellary Council of India (GJCI) organized at Port Blair, A&N Islands in association with the Small scale industries development department of A&N administration during 6-8 th May, 2008 - **Dr. V.Kripa**

One day workshop of NAIP on Oceanic Squids at Kochi on 27th March, 2009 - **Dr. V.Kripa**

Invited lecture on 'Impact of Mariculture on Biodiversity, Environment and People' by Prof. (Dr.) Mohan Joseph Modayil, Member, ASRB, New Delhi, organized by the Rajiv Gandhi Chair in contemporary studies, Cochin University of Science & Technology, Kochi on 25.07.2008 - **Dr. (Mrs.) Mary K. Manisseri, Smt.T.S.Naomi, Smt.Rekha J.Nair, Dr.Rema Madhu, Dr.K.Vinod, Dr.Molly Varghese**

Sub-committee meeting with officials of Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, Krishi Bhavan, New Delhi to finalize the guidelines for import of ornamental fishes at CMFRI, Cochin on 18.11.2008 - **Dr. (Mrs.) Mary K. Manisseri**

Participated in the workshop on 'Conservation of Sea Turtles and Mangroves' conducted by Canara Green Academy and Karnataka Forest Department at Sirsi in January 2008 - **Dr. V.S. Kakati**

'Refresher programme', for EIA officials at EIA, Kochi on 27.9.2008 - **Smt. Rekha J. Nair**

Personnel
(Senior positions only)

Director	Dr. G. Syda Rao
Heads of Divisions	
Fishery Resources Assessment Division	Dr. E. Vivekanandan
Pelagic Fisheries Division	Dr. N. Gopalakrishna Pillai
Demersal Fisheries Division	Dr. E. Vivekanandan
Crustacean Fisheries Division	Dr. E.V. Radhakrishnan
Molluscan Fisheries Division	Dr. K.Sunilkumar Mohamed
Fishery Environment Management Division	Dr. A. Laxminarayana / Mrs. Grace Mathew
Marine Biotechnology Division	Dr. K.K. Vijayan
Socio-Economic Evaluation & Technology Transfer Division	Dr. R. Sathiadhas
Marine Biodiversity Division	Dr. (Mrs.) Mary K. Manisseri
Mariculture Division	Dr. G. Gopakumar
Sr. Administrative Officer	Smt. Roja Sethumadhavan
Sr. Finance & Accounts Officer	Shri. G. P. Sharma
Scientists-in-Charge of Regional/Research Centres	
Mandapam Camp	Dr. G. Gopakumar
Chennai	Dr. H. Mohamed Kasim
Tuticorin	Dr. P. Muthiah
Karwar	Dr. V.S. Kakati / Dr. K. K. Philipose
Mangalore	Dr. A.P. Dinesh Babu
Veraval	Dr. G. Mohan Raj/ Dr. Gulshad Mohamed
Vizhinjam	Dr. (Mrs.) Rani Mary George
Mumbai	Dr.V.D. Deshmukh
Visakhapatnam	Dr. P. Kaladharan
Calicut	Dr. P.N. Radhakrishnan Nair
Krishi Vigyan Kendra, Narakkal	Dr. Ashok Kumaran Unnithan

Official Language Implementation Activities for the year 2008-2009

1. Ensurance of bilingualisation and targets of correspondence

During the year Cent percent bilingual issue of Section 3(3) documents (1652 nos.), reply of letters received in Hindi itself (1462) and target of Hindi correspondence (82% against the target of 55%) (462) were ensured.

Under bilingualisation of stationery items 67 name plates, 38 rubber stamps, Museum labels (239), identity cards 24 renewed; 3 plaques, 2 invitation cards, 4 charts, 49 certificates newly prepared; standard drafts 23 Nos. used by the Mumbai, Vizhinjam, Karwar and Mandapam Regional/Research Centres revised.

2. Official Language Implementation Committee meetings.

The 75th, 76th and 77th meetings of Official Language Implementation Committee of the Institute were held on 17-5-2008, 15-9-2008 and 27-01-2009. The standard agenda items discussed; action planner for the year chalked out and programmes implemented.

3. Review of work of Centres

The Official Language implementation activities of 10 Regional / Research centres were reviewed and suggestions were given for improvement.

4. Check Points

In order to ensure the instruction on Official Language check points have been fixed at various levels and circulated for compliance at the Institute and Centres.

5. Inspections

a) Parliamentary Committee inspection: Second sub committee of the Parliamentary Committee on Official Language inspected the implementation activities of Mandapam Regional Centre of CMFRI on 1-12-2008.

b) ICAR inspection: Under Secretary (Admn.) , ICAR, New Delhi inspected the Official Language implementation activities of CMFRI Headquarters on 11-06-2008.

c) Outstation inspections: Director, CMFRI inspected the Official Language implementation activities of Calicut Research Centre on 09-04-2008 and 2-02-2009, Mangalore RC on 11-04-2008, Visakhapatnam Regional Centre on 25-04-2008 and Veraval Regional Centre on 29-12-2008 .

6. HRD programmes

a) Hindi Workshops: Inorder to enable the staff to work in Hindi,

Chief Guest .Shri O.P. Sachan, Chief Commissioner of Income Tax, Cochin addressing the staff members

2 Hindi Workshops were conducted at Headquarters from 18 & 19-12-2008 & 26-27 March 2009, one at Veraval Regional Centre on 30-07-2008, one at Mangalore Research Centre on 26-11-2008 & 2 at Calicut Research Centre on 03-04-2008 & 12-06-2008.

b) Correspondence Course: Out of 8 Ministerial staff underwent Hindi Typewriting correspondence course 7 have passed.

c) A word a day: Under *A word a day* programme around 290 Hindi words with English equivalents were displayed on computers and on the display board.

d) Special incentive scheme: Under the scheme 18 officers/staff won cash awards. Special incentive scheme has been introduced at Mangalore and Calicut Research Centres during the year.

e) Participation in Town Official Language Implementation Committee activities: CMFRI bagged 6 prizes conducted by the Town Official Language Implementation Committee activities.

7. Extension programmes

a) Hindi Chethana Maas 2008

Hindi Chethana Maas was observed at CMFRI Headquarters from 1 to 30 September 2008 with various competitions / programmes. Shri O.P. Sachan, Chief Commissioner of Income Tax, Cochin was the Chief Guest of Valedictory function. Winners of competitions and overall contributors for the year were felicitated during the function.

b) Scientific Seminars

At CMFRI, Kochi Seminar on Coastal Zone Management

In order to disseminate the Research achievements in Official Language Hindi a Scientific seminar was organized at CMFRI Headquarters on the subject *Coastal Zone Management* on 30-05-2008. 16 Research papers and 2 Official Language articles were presented in Hindi by Scientists/Official Language Officers. The proceedings was released on this occasion by the Chief Guest Smt. Sobha Koshy, IPS, Post Master General, Kochi. Recommendations passed in the plenary session were forwarded to ICAR for necessary action. Best presentation awards were bagged by Smt. Bindu Sulochanan, Scientist, Mandapam Regional Centre representing region 'C' and Dr. V.V. Singh, Principal Scientist, Mumbai Research Centre representing region 'A'.

Smt.Sobha Koshy, IPS, Post Master General, Kochi releasing the proceedings of Seminar Coastal Zone Management

At Visakhapatnam Regional Centre of CMFRI, Seminar on Marine Fisheries of Andhra Pradesh

A scientific seminar was organized at Visakhapatnam Regional Centre on the subject *Marine Fisheries of Andhra Pradesh* on 30-09-2008. 14 Research papers were presented in Hindi by the Scientists/ Technical staff and the proceedings released.

c) Popular articles

Two articles in Hindi on *Athangavat Se kaise lade* and *vaanijyik Krishi*

anusandhan Desh Ke vikas ke liye were published in CMFRI Recreation Club magazine *Tharangam.*

d) Hindi in education

3 Research abstracts of Ph.D students were prepared in Hindi.

e) Library Service

Hindi books worth Rs. 46195/- were purchased for CMFRI Headquarters and outstations. Purchase of popular Hindi newspaper and periodicals continued.

f) Press and Editorial work performed

a. Quarterly bilingual periodicals

MFIS - Issue Nos. 194, 195 & 196

CMFRI Newsletter - Issue Nos. 116,117 & 118.

b. Special publications in Hindi

Matsyagandha - 2007

Coastal Zone Management

c. Hindi pamphlet - CMFRI ki jhankiyam

d. Hindi wall magazine - April - 2008 to February- 2009 issues displayed.

e. Annual Report 2007-08 with Hindi Executive Summary

g) e-governance programme continued

i. Online display of *Todays Word*

ii. LAN facility of bilingual standard drafts and forms

iii. Web display of Tender Notice/ Announcement

iv. Updation of Hindi website.

v. Use of bilingual software for fishing data collection.

h) Programmes hosted

For Central Hindi Training Institute:-

CMFRI hosted three days Hindi typewriting correspondence training course of Hindi Teaching Scheme, New Delhi during 15-17 December, 2008.

For Kochi TOLIC:-

CMFRI hosted Hindi power point presentation and Hindi poster competitions of Cochin Town Official Language Implementation Committee on 02-03-2009.

i) Awards

Smt. Rekha J. Nair, Scientist (SG) won One All India Hindi Essay Competition for her research article in Hindi on the subject *Conservation of Marine diversity in India*.and received award and certificate from Kendriya Hindi Sachivalaya parishad, New Delhi

Distinguished Visitors

Headquarters

- In addition to VIPs, 540 farmers, students and entrepreneurs visited the Institute headquarters during the quarter.
- Hon'ble Administrator of Lakshadweep, Shri B.V.Selvaraj, IAS visited the National Repository Museum and Hatchery at Headquarters on 19th September, 2008.
- As much as 1053 farmers, students and entrepreneurs visited ATIC during the quarter.

Karwar Research Centre

- Prof. (Dr.) S. M. Shivaprakash and Prof. (Dr.) M. N. Venugopal of College of Fisheries, Mangalore visited the Centre along with 28 B. F. Sc. Students on 8th April, 2008.
- Dr. V. V. Sugunan, ADG (Inland Fisheries), ICAR and Smt. G. K. Vinci, Principal Scientist, CIFRI Barrackpore, visited the Centre on 21st May, 2008.

Tuticorin Research Centre

- Lt. Col. A.K. Rai, 28(TN)Br NCC, Virudhunagar visited the Centre.
- Mr. Michael Hobday, Penrallt, KTZO 6HL, England visited the Centre.
- Teachers and a total of 254 students from various schools and colleges of Tamil Nadu and Kerala visited the Centre.
- Students 339 Nos. along with their faculty from Colleges/Schools from Tamil Nadu and Kerala visited the centre.

Mandapam Regional Centre

- Mr. Rakesh Kumar Jagaria, I.F.S., Wildlife Warden- In-Charge, Gulf of Mannar Marine National Palk (GMMNP), Ramanathapuram visited the Centre on 21st June, 2008.
- A total of 694 students from various schools/ colleges and 1304 general public visited the Centre during the quarter.

Veraval Regional Centre

- Mr. Mohan Kumar, IAS, Chairman, MPEDA visited the Centre on 9th April, 2008.
- Dr. S. Ayyappan, DDG visited VRC of CMFRI on 03.03.09.
- Dr. Venkatesan Venugopal Retd. Director, MPEDA visited VRC of CMFRI on 21.03.09.
- NGO: Gramya Vikash Trust from Dwarka visited VRC of CMFRI on 24.10.08.
- NGO: Vivekananda Research and Training Institute from Nalliya visited VRC of CMFRI on 06.01.09.

Mangalore Research Centre

- Dr. G. SydaRao, Director, CMFRI, Kochi visted the centre on 29-08-2008 and 30-08- 2008.
- Dr. Suresh. S. Honnappagol, Vice-chancellor, Karnataka Veterinary, Animal and Fisheries University, Bidar visited the centre on 30-08-2008.
- Shri. M. Karkera, Member Board of Management, Bidar visited the centre on 30-08-2008.
- Shri. R.V. Garag, Comptroller, Karnataka Veterinary, Animal and Fisheries University, Bidar visited the centre on 30-08-2008 .
- Dr. Y. Basavaraju, Dean ,College of Fisheries, Mangalore visited the centre on 30-08-2008 .
- Dr. Roshni, M. Lecturer, Biochemistry, and 21 students of P.G Biochemistry from St.Aloyceious College, Mangalore visited the centre on 08-09-2008.

Visakhapatnam Regional Centre

- Dr. C. Vasudevappa, Senior executive Director of NFDB, Hyderabad visited the centre on 1-11-2008.
- Dr. Mangala Rai, Secretary, DARE and DG, ICAR visited the Visakhapatnam Centres of CMFRI and CIFT on 28-11-2008 and interacted with all the scientists.
- Eight officers from Export Inspection Authority, Chennai Circle, Ministry of Commerce, Govt. of India on 4-10-2008.
- High school students from institutions in and around Visakhapatnam from Oct- Dec 2008.
- B.Sc students from Aquaculture Dept, Govt. Degree College , Guntur on 15-12-2008.
- M.Sc. students from V.S.Krishna College, Visakhapatnam on 18-11-2008.

Mumbai Research Centre

- Dr.S.K.Ghosh, General Manager, NABARD, Pune on 15-11-08.
- Shri P.S.Kelkar, Scientist NEERI, Nagpur, Deputy\ Director and Head Geo-Gm management Division on 26-11-08.
- Smt. Shivani Dhage, Scientist, NEERI, Deputy Director,Worli on 26-11-08.
- Shri.Amrhi Singh Bhatia, IA&AS, Accountant General (Retd.) 357, Shivalisc City, Khaqar, (Mohali) Punjab.
- 704 students along with faculty members of various colleges/schools of Tamil Nadu & Kerala visited during this period.
- **ATIC, CMFRI, Kochi** : As much as 4223 students, 389 stakeholders and 28 VIPs' visited ATIC during the period.

कार्यकारी सारांश

देश का समुद्री मछली अवतरण पिछले वर्ष के आकलन के मद्दे 11% वृद्धि के साथ 3.27 लाख टन के अधिक पकड से 3.21 मिलियन टन पहुँच गया। कुल पकड का 53% पेलाजिक फिन फिश, 27% डमर्सल, 15% क्रस्टेशिया और 5% मोलस्क वर्ग थे। समुद्री मछलियों में तारली सारडिनेल्ला लोंगिसेप्स सब से अधिक प्राप्त हुआ जो कि 444593 टन (14%) था। इसके पीछे पीनेइड झींगे की पकड थी। सब से उत्पादकीय क्षेत्र पश्चिम तट और राज्य केरल थे। केरल का योगदान 21% और इसके पीछे 19% पकड के साथ गुजरात आए। कुल मछली अवतरण के बाज़ार भाव में 29% वृद्धि हुई। प्राथमिक मार्केट लेवल में यह 17,133 करोड रु और रीटेल मार्केट लेवल में 24,934 करोड रु था। मछुआरों के कन्स्यूमर रुपया प्रतिशत शेयर (PSFCR) में भी वृद्धि हुई। शेफरियन अध्यन (schaeferian studies) के सिमुलेशन अभ्यासों से इन्हीं पारामीटरों का मूल्यांकन करने का कोशिश किया।

पिछले कुछ वर्षों से केरल की समुद्री मछली पकड में बढत की प्रवणता दिखाई पडती है। 2008 के दौरान 6.7 लाख टन मछली का अवतरण हुआ जो कि पिछले वर्ष की अपेक्षा 8% अधिक था जबकि अनुमानित उच्चतम टिकाऊ फसल (MSY) 6.99 लाख टन था।

मछली पकड का 71% पेलाजिक मछली थी जिस में तारली का योगदान सब से अधिक था। मानसूनोत्तर रोक के बाद की अवधि में अधिकांश पकड प्राप्त हुई थी। रिंगसीनों से प्राप्त पकड में तारली के तरुण बडी मात्रा में थे। उच्च दाम की मछली जैसी तटीय ट्यूना और महासागरीय ट्यूना की पकड में यथाक्रम 23% और 39% वृद्धि हुई। तमिलनाडु और पुदुच्चेरी का औसत शक्य फसल और शक्य फसल यथाक्रम 396880 मेट्रिक टन और 43549 मेट्रिक टन आकलित किया। पोर्ट्नोवो कर्कट और कुछ पेनिअइडों के माध्य आकार में दिखाई पडी कमी का कारण ट्राल जाल से किए जानेवाला वर्धित मत्स्यन प्रयास से जोडा गया। मिनिकोय और अगत्ती द्वीपों में नवंबर और जनवरी के दौरान पोल मत्स्यन केलिए उपयोगित जीवंत चारा मछलियों में कमी महसूस की गई, इसके टिकाऊ प्रबंधन की आवश्यकता है। मात्स्यिकी संसूचना नेटवर्क के ज़रिए शक्य मत्स्यन मेखलाओं का पहचान और निर्धारण से कम खर्च में ट्यूणा पकड बढाया जा सकता है।

कर्नाटक और गोवा की मछली पकड में पिछले वर्ष की तुलना में यथाक्रम 13% और 14% वृद्धि हुई। बहुदिवसीय ट्राल प्रचालन से कर्नाटक में 48% पकड प्राप्त हुई। पकड में तारलियाँ और इसके पीछे थ्रेडफिन ब्रीम प्रचुर थीं; उच्च दाम के शीर्षपाद और श्रिंप भी प्राप्त हुए। गोवा की पकड में तारली और बाँगडा प्रचुर मछलियाँ थी। पश्चिम तट के 8°-20°N लटिट्यूड में किए अन्वेषणात्मक सर्वेक्षण ने व्यक्त किया कि 600-800 मी की गहराई में संपदाओं की वैविद्यपूर्ण प्रचुरता है।

महासागरीय ट्यूना मछली (Oceanic tuna) पर किए अन्वेषणात्मक सर्वेक्षण ने इसके पकड की गुंजाईश सूचित की जबकि तटीय ट्यूना की पकड अनुकूलतम स्तर के बराबर पहूँच गया है। पश्चितम तट में गहरा सागर सुराओं (deepsea shark) को लक्ष्य करके किए गए मत्स्यन में 14 जातियों के सुरा और किमेरा (chimaera) प्राप्त हुए। मानसूनोत्तर अवधि में ड्रिफ्ट गिलनेट के ज़रिए ब्रांबल शार्क (Bramble shark) का अवतरण हुआ। सारे मत्स्यन अवतरण केंद्रों में पकडी गई कचड़ा मछली का मॉनिटरन किया गया। तिरुप्पालैकुडी और देविपट्टणम में तल्लुवलै के परिचालन से तरुण मादा झींगों के नाश होने की रिपोर्ट की गई। भारत के तटों में पेनिअइड झींगों के पुर्नभरण गतिकी (recruitment dynamics) संबंधी अध्ययन पर ज़ोर दिया; मुंबई और माँगलूर तटों के अवतरण में घटती की प्रवणता दिखाई पडती है।

एन ए आइ पी (NAIP) परियोजना के अंदर लक्षद्वीपसागर की महासागरीय ट्यूना संपदा पर तीन परियोजनाएं शुरू की गई और ट्यूना सैलेज (tune silage) से विकसित **कडलमीन साइले** नामक मछली खाद्य का परीक्षण और प्रयोगार्थ विमोचन किया गया। महाचिंगट (lobster) संपदाओं के संरक्षणार्थ सहयोगी सर्वेक्षण तकनीक आगे बढाया गया। वेरावल से विदोहित प्रमुख पेलाजिक संपदा *थन्नस टोंगोल* का पकड कार्य अनुकूलतम स्तर से ऊपर पाया गया। वर्ष के दौरान भी मौसमिक परिवर्तन से समुद्री मछलियों पर होनेवाले प्रभाव संबंधी अध्ययन जारी रखा। अध्ययनों ने व्यक्त किया कि उच्च मत्स्यन दबाव होने पर भी पारिस्थितिक तंत्र की छोटी वेलापवर्ती सस्यभक्षियों की बढती में मंदता न होगी। मछली पकडने के यांत्रिक नावों, गिलनेटेरों और डोलनेट्टरों से छोडने वाले CO_2 की मात्रा आशंकाजनक नहीं देखा गया। समीपस्थ समुद्रों के समुद्री सस्तनियाँ संबंधी अध्ययन जारी रखा। कोचीन पश्चजल इन्डो पसिफिक हंपबैक डॉलफिन *सोसा चिनेनसिस* का अच्छा अशन व आवास केंद्र के रूप में महसूस किया गया। भारत के समुद्रों में करीबन 1899 तिमियों और डॉलफिनों को देखा गया जो इस बात का सूचक है कि यह क्षेत्र इन्हीं जीवों के लिए अनुयोज्य है।

आंध्राप्रदेश की मछली अवतरण में धीमी सी बढ़ती देखी गई। यह बढती वेलापवर्ती मछलियाँ तारली, बाँगडा और फीतामीन के कारण थी। *लेलिगो डुवासेली*, *मेटापेनिअस मोनोसिरोस*, *एम. डॉबसोनी* की पकड अनुकूलतम स्तर से ऊपर थी; यह पकड में भी दृश्य था। गुजरात में ट्राल मत्स्यन उत्तरदायित्वपूर्ण ढंग से करने केलिए निर्धारित जालाक्षि आयाम पर शुरूआती परीक्षण किया गया।

ट्रॉफिक मॉडलिंग अध्ययनों ने व्यक्त किया कि कोरमंडल तट में पकडी जैव संपदा पकड मान्नार की खाडी की संपदा से अलग है। पुरातत्व डाटा विश्लेषण रीतियों के ज़रिए इन पारिस्थितिक तंत्रों में किए अध्ययनों ने व्यक्त किया कि केरल की 16 और कर्नाटक की 4 जातियों के संबंध में पिछले 20 साल से रिपोर्ट उपलब्ध नहीं है अतः ये वंशनाश की भीषणी में है। शिंगटी (catfish) के स्टॉक में क्षीणता केरल और कर्नाटक में दिखाई पडती

है और इन्हीं प्रांतों के यथाक्रम K_1 और K_2 और KN_{14} मेखलाएं इस क्षीणायमान स्थिति के कारण मरैन प्रोटक्टड क्षेत्र के रूप में पहचाना गया है। क्लाऊन फिश को खिलाने केलिए बनाए गए सूत्रित खाद्य ने रंगकता व अतिजीविताता संबंधी अच्छा परिणाम दिखाया। शूली महाचिंगट *पानुलिरस होमारस* को खिलाने केलिए बनाए सूत्रित खाद्य का प्रारंभिक प्रयोग आशाजनक देखा गया। ट्यूना की 6 जातियों और शिंगटी की 3 जातियों पर किए डी एन ए बारकोडिंग (DNA barcoding) पूरा किया और शिंगटी का Col gene सीक्वनस भी NCBI जीन बैक में जमा किया। समुद्री पखमछलियों और कवच मछलियों के संवर्धन में दिखाए पडनेवाले रोग कारण संबंधी अध्ययन में मुक्ताशुक्तियों में मिक्सोपोरियन (myxosporean), अकान्तोसेफालन (acanthocephalan) और नेमाटोड (nematod) परजीवियों को पहचाना गया। *इपिनेफेलस मलबारिकस* (*Epinephelus malabaricus*) के क्लोम, स्प्लीन (spleen) और हृदय ऊतक से सेलकल्चर लाइनों का विकास किया। जैवपूर्वेक्षण अनुसंधान में हरित शंबु *पी. विरिडिस* से एक पौष्टिज का विकास किया। नेत्रवृंत अपरदन (eye stalk ablation) में परिवर्तन लाने को GIH antagonist का विकास इस तकनीक को त्वरित करने में सहायक होगा। जैवप्रौद्योगिकी अनुसंधान में पखमछली डिंभक पालन केलिए उपयोगी एक देशी संपुष्ट पदार्थ का विकास को रहा है।

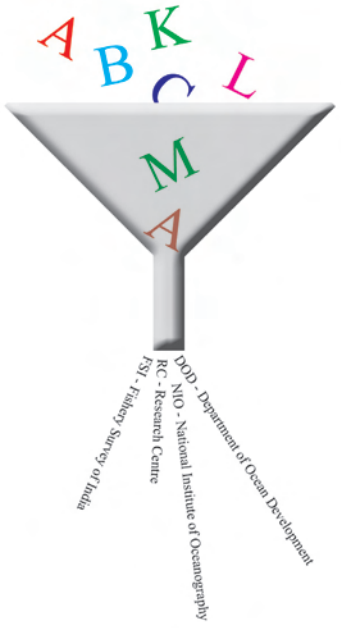
परंपरागत सेक्टर में PPAR के ज़रिए किए गरीबी संबंधी अध्ययनों ने व्यक्त किया कि कर्नाटक पहले स्थान पर है और इसके नीचे तमिलनाडु है। करांक्स सेक्सफासियाटस (*Caranx sexfasciatus*) को छोटे पिंजरों में पालन करने का तीव्र श्रम किया गया; अनुकूल अतिजीविताता देखा था। अन्तर्जलीय Line Intercept Transect रीति से पाक खाडी और GOMBR के प्रवालें और जैवविविधता का अध्ययन किया गया। वर्ष 2004 की तुलना में पाक खाडी की प्रवाल क्षेत्र में 41 से 13% की घटती देखी; प्रवाल समुदायों में भी फरक देखा। लूटजानिडे परिवार मछलियों की जैवविविधता और जाति व्यतियान संबंधी अध्ययन शुरू किया; विविध क्षेत्रों से 26 लूटजानिडे जातियों का संग्रहण किया।

संवर्धन अनुसंधान में कोबिया, पोम्पानो, ग्रूपर मछलियों का सफलतापूर्ण विकास किया। 8 समुद्री अलंकारी मछलियों का अंडशावक विकास और परिमार्जन हो रहा है। *पी. बयाकुलेटस* का तरुणपालन और *पी. डायलेक्टस* का बंधित प्रजनन सफल रूप से कर दिया।

संस्थान के वैज्ञानिकों द्वारा 7 किताबों व विशेष प्रकाशनों और 65 अनुसंधान प्रलेखों का प्रकाशन किया। इसके सिवा समुद्री संवर्धन, जैवप्रौद्योगिकी और समुद्री मात्स्यिकी विषयों पर लोकप्रिय लेखों का प्रकाशन किया। संस्थान के 5 वैज्ञानिकों ने राष्ट्रीय स्तर का अवार्ड और 2 ने अन्तराष्ट्रीय छात्र वृत्ति प्राप्त की; 3 को अपने कार्य केलिए डॉक्टरी उपाधि प्रदान की।

संस्थान ने वर्ष के दौरान निजी और सार्वजनिक क्षेत्रों में चलाए परमार्श परियोजनाओं से 1,69,00,083 लाख रु. कमाया। संस्थान ने महासागरीय स्क्विडों और कवचमछली समुद्री संवर्धन केलिए यथाक्रम 541 लाख रु और 352 लाख रु के दो बहुशाखीय, बहु संस्थानीय परियोजनाएं प्राप्त कीं। संस्थान के वैज्ञानिकों ने मिनिस्ट्री आफ एर्थ साईंसस, डिपार्टमेन्ट आफ बयोटकनालजी, डी एस टी व समुद्री उत्पाद निर्यात विकास प्राधिकरण द्वारा निधीयन की योजनाएं प्राप्त की।

Acronyms Used



ADAK	Association for Development of Aquaculture in Kerala
ATIC	Agricultural Technology Information Centre
BFFDA	Brackishwater Fish Farmers Development Agency
CARI	Central Agricultural Research Institute
CIBA	Central Institute of Brackishwater Aquaculture
CIFA	Central Institute of Freshwater Aquaculture
CIFE	Central Institute of Fisheries Education
CIFT	Central Institute of Fisheries Technology
CMFRI	Central Marine Fisheries Research Institute
CoF	College of Fisheries, Mangalore
CUSAT	Cochin University of Science & Technology
DBT	Department of Biotechnology
DOD	Department of Ocean Development
DST	Department of Science & Technology
E	Exploitation Rate
FAO	Food and Agricultural Organisation
FSI	Fishery Survey of India
GAU	Gujarat Agricultural University
GOPL	GMR PSEG Operations Private Limited, Mangalore
IASRI	Indian Agricultural Statistics Research Institute
ICAR	Indian Council of Agricultural Research
IFS	International Foundation of Science
IGIDR	Indira Gandhi Institute of Development Research
IOTC	Indian Ocean Tuna Commission
ISD	Information System Development
IVLP	Institution Village Linkage Programme
KIOCL	Kudremukh Iron Ore Company Limited
KKV	Konkan Krishi Vidhyapeeth
MOES	Ministry of Earth Sciences
MOE&F / MEF	Ministry of Environment & Forest
MPEDA	Marine Products Export Development Authority
MRPL	Mangalore Refineries and Petrochemicals Limited
MSY	Maximum Sustainable Yield
NAARM	National Academy of Agricultural Research Management
NABARD	National Bank for Agricultural and Rural Development
NBFGR	National Bureau of Fish Genetic Resources
NGOs	Non-Governmental Organisations
NIO	National Institute of Oceanography
RC	Research Centre
RGCA	Rajiv Gandhi Centre for Aquaculture
RGCCS	Rajiv Gandhi Chair for Contemperory Studies
SEAFDEC	South East Asian Fisheries Development Centre
SFDs	State Fisheries Departments
TANUVAS	Tamil Nadu Veterinary and Animal Science University
WFC	World Fish Centre
Z	Mortality Rate